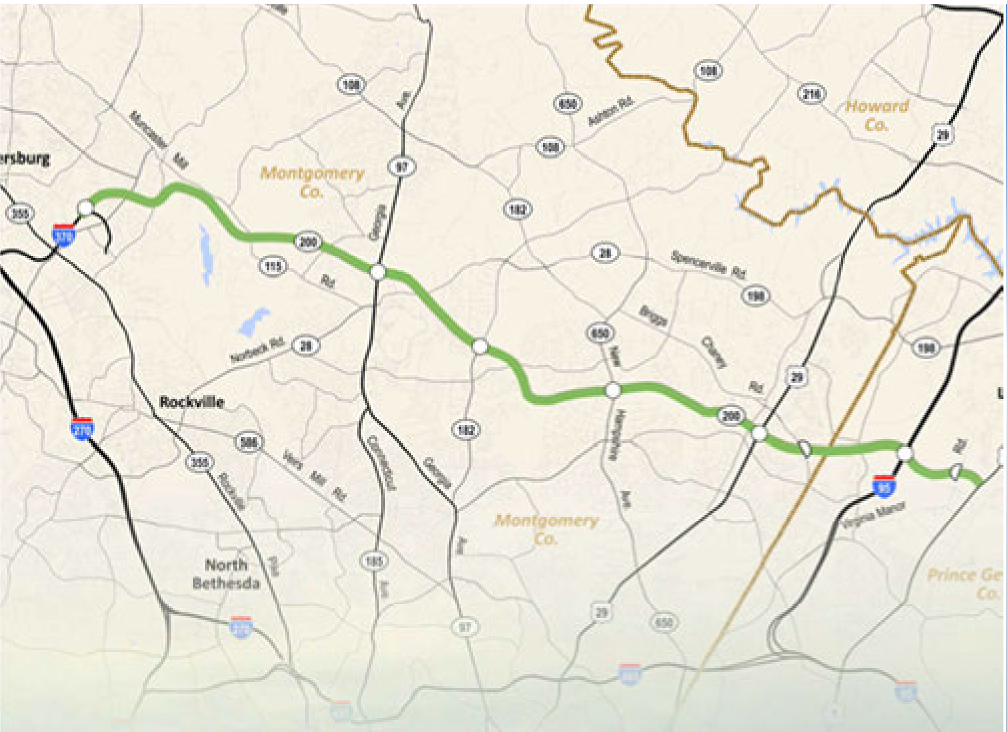
Intercounty Connector Comprehensive Traffic and Revenue Study



Final Report

Maryland Transportation Authority

January 2016

CDM Smith

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Executive Summary

Under contract to the Maryland Transportation Authority (MDTA), CDM Smith conducted a Comprehensive Traffic and Revenue Study for MD 200 / Intercounty Connector (ICC) operated by the MDTA. The purpose of the study was to provide a new traffic and revenue forecast for the ICC, which is now in its sixth year of operation. Prior forecasts were conducted before the facility was in operation, and the current study represents the first comprehensive study effort since the ICC opened to traffic in 2011. The most recent Metropolitan Washington Council of Governments (MWCOG) regional travel demand model was utilized along with refined socioeconomic data and forecasts for the region and specifically the Primary Market Area of the ICC. The model and forecast were benchmarked to current traffic and operating characteristics on the ICC and the surrounding roadway network. The latest information on future roadway improvement assumptions was assembled and included in the model. The calibrated and refined travel model was then utilized to develop traffic and toll revenue forecasts for the ICC through Fiscal Year (FY) 2040. This report summarizes the study effort, including historical traffic and toll revenue trends on the ICC, traffic counts and travel speeds of surrounding competing facilities, historical and future socioeconomic forecasts, the modeling methodology, and the transaction and toll revenue forecast.

ICC Description

The ICC opened to traffic in 2011 as the eighth MDTA toll facility and the first All-Electronic Toll (AET) road in Maryland. As shown in **Figure ES-1**, the ICC is an east-west limited access facility located in the Washington, D.C., and Baltimore metropolitan region. It connects I-370 in the Gaithersburg area to I-95 and US 1 in Laurel. The ICC is primarily three lanes per direction with a posted speed limit of 60 MPH between I-370 and US 29 and 55 MPH between US 29 and US 1. **Figure ES-2** illustrates the existing configuration of the ICC and indicates the location of interchanges and toll gantries. There are currently six toll gantries per direction that cover movements between nine interchanges.

Tolls on ICC are assessed based on particular interchange-to-interchange movements, as shown in **Table ES-1**. Tolls range from $0.40 to $3.86 for E-ZPass® customers depending on the length of the trip. Higher tolls are assessed on weekdays during Peak Period travel hours, which include 6:00 – 9:00 AM and 4:00 – 7:00 PM, than during Overnight Period hours (11:00 PM – 5:00 AM) or Off-Peak Period hours (all other hours). These toll rates reflect the toll changes implemented on July 1, 2015 (beginning of FY 2016) which reduced prior toll rates by $0.03 per mile. This new toll structure is assumed to be in place through the forecast.

On the weekends, tolls also differ between the Overnight Period (11:00 PM – 5:00 AM) and Off-Peak Period (5:00 AM – 11:00 PM). Tolls are collected using an AET system, through the use of an E-ZPass® transponder. For those customers without an E-ZPass® transponder, an image of the customer's license plate is taken and the customer is then mailed a bill. In order to encourage E-ZPass® usage and offset the additional processing costs associated with video tolling, toll rates for video customers are 50 percent more than those using E-ZPass®, with a minimum difference of $1.00 and a maximum difference of $15.00. Toll rates are greater for commercial vehicles based on the number of axles.

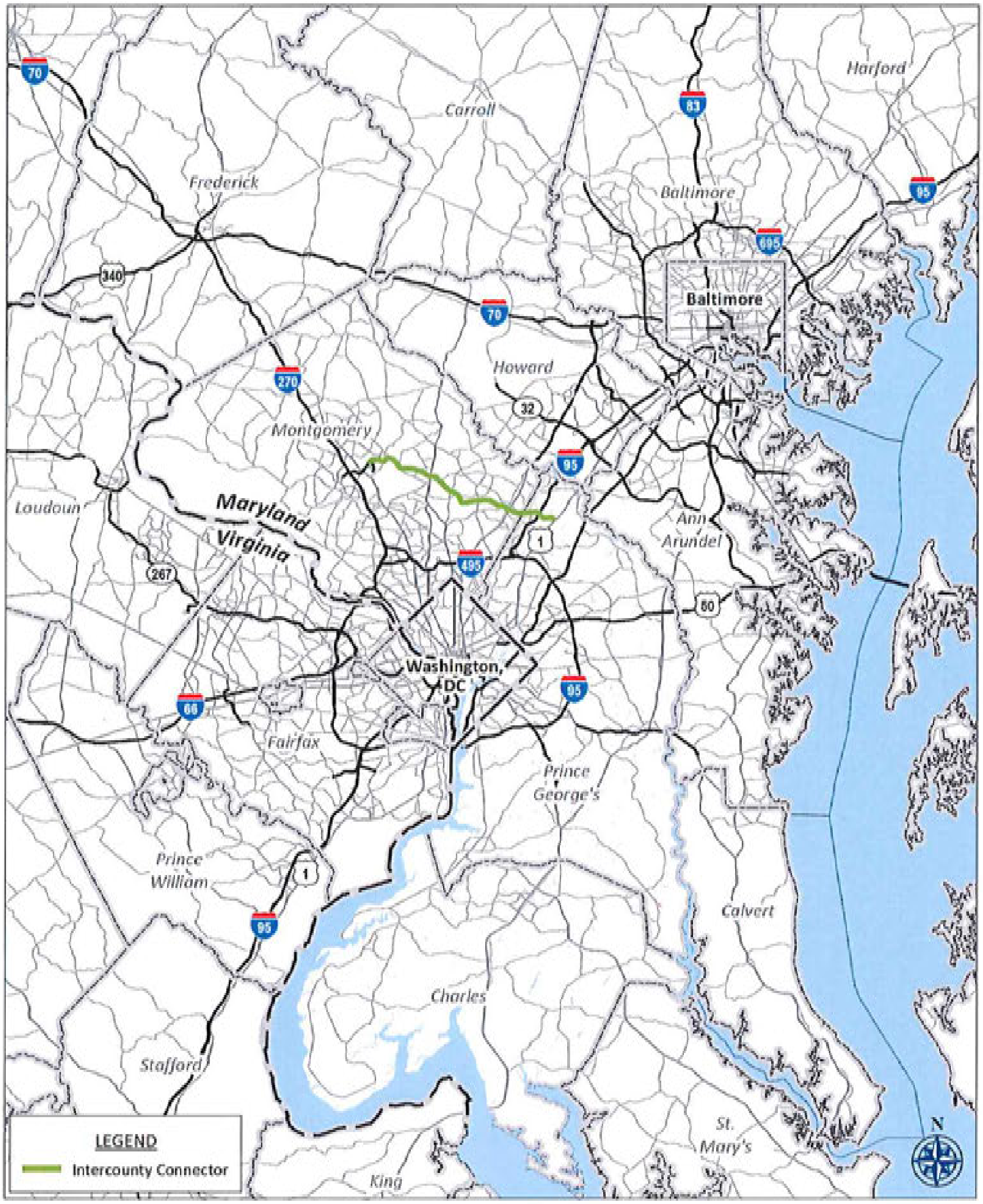


Figure ES-1
Regional Area Map

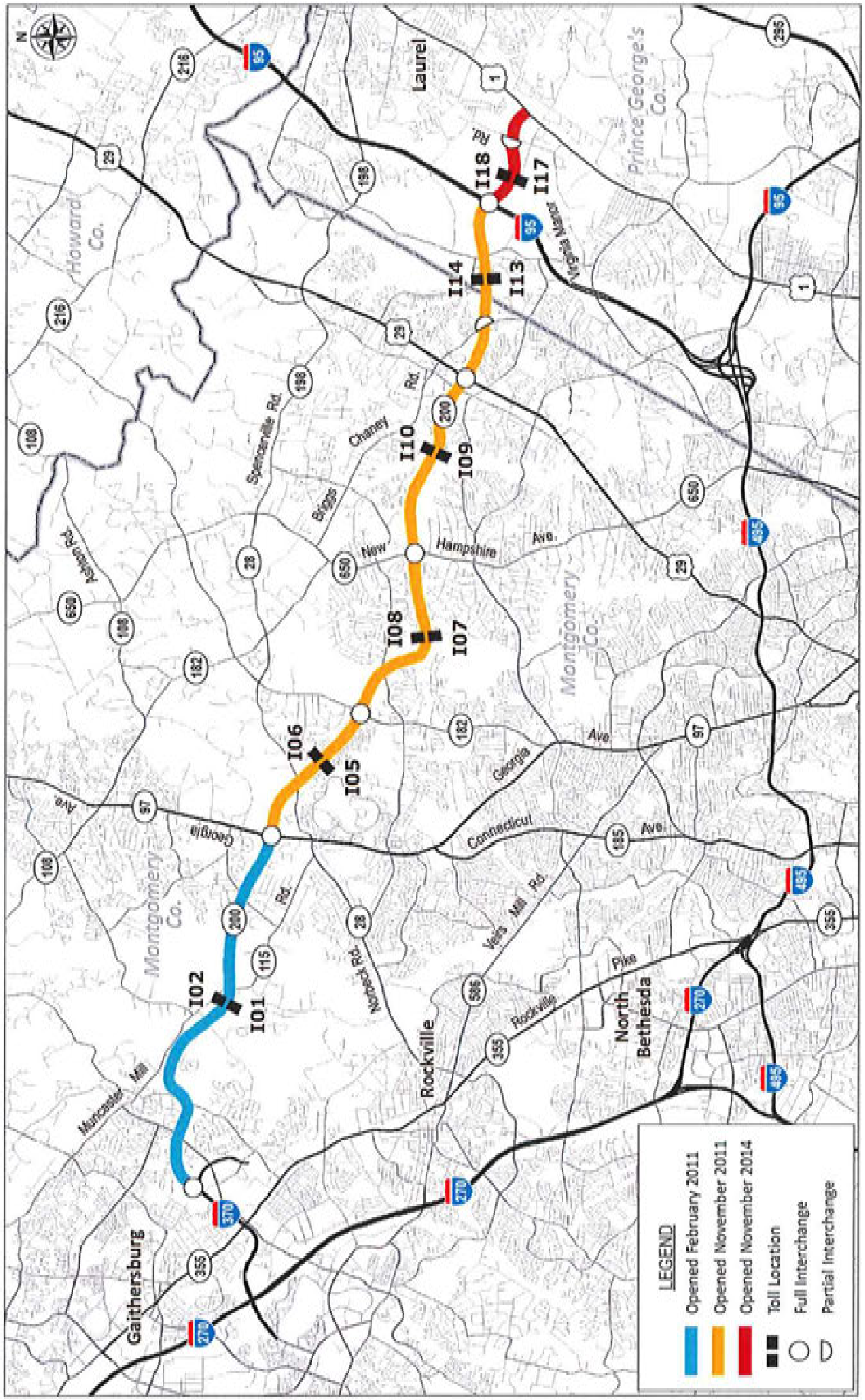


Figure ES-2
Intercounty Connector Location Map

Table ES-1
FY 2016 Passenger Car E-ZPass® Toll Rates by Movement and Time Period on the Intercounty Connector

		Exit						
Entrance	Time Period	I-370; Shady Grove Rd.	SR 97 / Georgia Ave.	SR 182 / Layhill Rd.	SR 650 / New Hampshire Ave.	US 29 and Briggs Cheney Rd.	I-95	Konterra Dr. and US 1
I-370; Shady Grove Rd.	Peak Period		$ 1.24	$ 1.74	$ 2.37	$ 2.92	$ 3.52	$ 3.86
	Off-Peak Period		$ 0.96	$ 1.35	$ 1.83	$ 2.26	$ 2.72	$ 2.98
	Overnight		$ 0.40	$ 0.56	$ 0.75	$ 0.93	$ 1.12	$ 1.23
SR 97 / Georgia Ave.	Peak Period	$ 1.24		$ 0.50	$ 1.13	$ 1.68	$ 2.28	$ 2.61
	Off-Peak Period	$ 0.96		$ 0.40	$ 0.87	$ 1.30	$ 1.76	$ 2.02
	Overnight	$ 0.40		$ 0.40	$ 0.40	$ 0.53	$ 0.72	$ 0.83
SR 182 / Layhill Rd.	Peak Period	$ 1.74	$ 0.50		$ 0.62	$ 1.18	$ 1.78	$ 2.11
	Off-Peak Period	$ 1.35	$ 0.40		$ 0.48	$ 0.91	$ 1.37	$ 1.63
	Overnight	$ 0.56	$ 0.40		$ 0.40	$ 0.40	$ 0.56	$ 0.67
SR 650 / New Hampshire Ave.	Peak Period	$ 2.37	$ 1.13	$ 0.62		$ 0.55	$ 1.15	$ 1.49
	Off-Peak Period	$ 1.83	$ 0.87	$ 0.48		$ 0.43	$ 0.89	$ 1.15
	Overnight	$ 0.75	$ 0.40	$ 0.40		$ 0.40	$ 0.40	$ 0.47
US 29 and Briggs Cheney Rd.	Peak Period	$ 2.92	$ 1.68	$ 1.18	$ 0.55		$ 0.60	$ 0.94
	Off-Peak Period	$ 2.26	$ 1.30	$ 0.91	$ 0.43		$ 0.46	$ 0.72
	Overnight	$ 0.93	$ 0.53	$ 0.40	$ 0.40		$ 0.40	$ 0.40
I-95	Peak Period	$ 3.52	$ 2.28	$ 1.78	$ 1.15	$ 0.60		$ 0.44
	Off-Peak Period	$ 2.72	$ 1.76	$ 1.37	$ 0.89	$ 0.46		$ 0.40
	Overnight	$ 1.12	$ 0.72	$ 0.56	$ 0.40	$ 0.40		$ 0.40
Konterra Dr. and US 1	Peak Period	$ 3.86	$ 2.61	$ 2.11	$ 1.49	$ 0.94	$ 0.44	
	Off-Peak Period	$ 2.98	$ 2.02	$ 1.63	$ 1.15	$ 0.72	$ 0.40	
	Overnight	$ 1.23	$ 0.83	$ 0.67	$ 0.47	$ 0.40	$ 0.40	

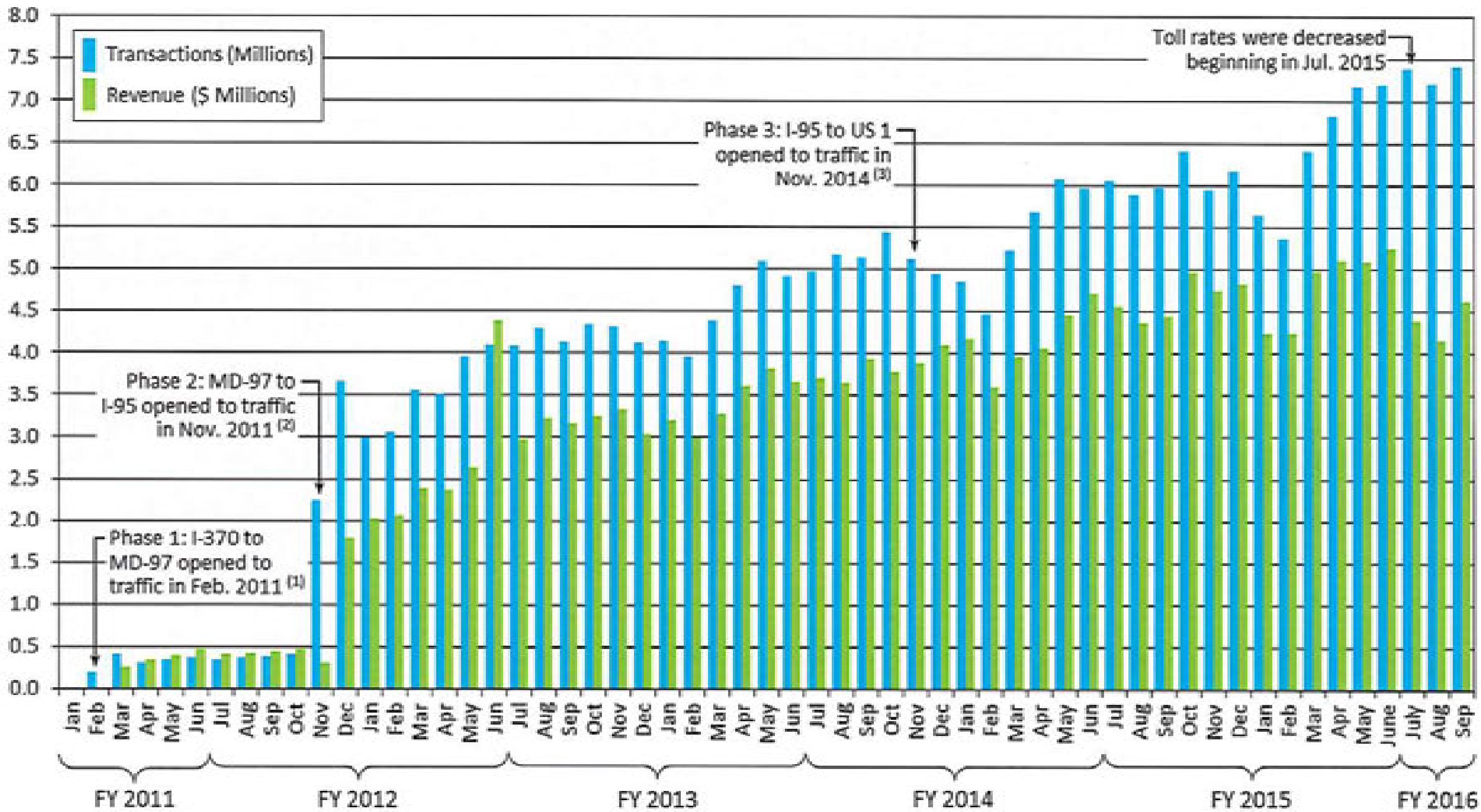
Note:
Peak Period is defined as 6:00 - 9:00 AM and 4:00 - 7:00 PM on Weekdays (excluding federal holidays).
Off-Peak Period is defined as 5:00 - 6:00 AM, 9:00 AM - 4:00 PM, and 7:00 - 11:00 PM on Weekdays and 5:00 AM - 11:00 PM on Weekends and federal holidays.
Overnight is defiend as 11:00 PM - 5:00 AM every day.

Historical Transaction and Revenue Trends

Historical transaction and toll revenue data were assembled to review growth trends and patterns. Transaction and toll revenue data cover the period from February 2011, when the first segment of the ICC opened, to September 2015, as shown in **Figure ES-3**. The ICC opened in segments, beginning in February 2011 with the roughly 5.5 mile segment from I-370 to MD 97 / Georgia Avenue. The second segment of the ICC opened from MD 97 / Georgia Avenue to I-95 on November 22, 2011. The last segment opened between I-95 and US 1 on November 7, 2015.

In January 2012, the first full month of toll operation of the ICC between I-370 and I-95, a total of 2,999,797 transactions were recorded for the ICC system as a whole. Transactions then increased by a total of 84 percent from FY 2012 to FY 2013 and 20 percent from FY 2013 to FY 2014 system-wide.

This high growth is primarily due to the phenomenon of facility "ramp-up," where motorists over time adjust their travel patterns as they become aware of a new facility and the benefits that it has to offer over their current route of travel. This ramp-up period continued into FY 2015, with a 19.1 percent growth in transactions and an 18.4 percent growth in toll revenue. Transactions in FY 2016 (July through September 2015) grew at a faster rate than FY 2015, which can be attributed to the toll reduction implemented in July 2015. Toll revenue for the three months shown in FY 2016 are comparable to those experienced in FY 2015, which reflects the lower toll in combination with continued robust growth in transactions.



[1] The segment between I-370 and MD 97 (location of Toll Gantries I01/I02) opened on February 23, 2011 and was the only segment open in FY 2011. The segment operated toll free until the beginning of E-ZPass® toll operations on March 7, 2011 and the beginning of video toll operations on April 6, 2011.

[2] Toll Gantries I05/I06, I07/I08, I09/I10, and I13/I14 opened in November 22, 2011 (FY 2012). Toll operations began December 5, 2011.

[3] Toll Gantries I17/I18 opened November 10, 2014 (FY 2015).

Figure ES-3

Intercounty Connector Monthly Toll Transaction and Revenue Trends

2014 Average Weekday Traffic Volumes

A balanced traffic profile of 2014 Annual Average Weekday Traffic (AAWDT) volumes for each ICC ramp and mainline section was developed as part of the model calibration process in order to compare the model's traffic assignment output with actual traffic volumes. The balanced profile is shown in **Figure ES-4**. Traffic averaged about 41,000 on the west end of the ICC facility, remaining fairly consistent until the US 29 interchange where traffic is around 30,000 for the mainlines to the east of US 29. The heaviest interchange volumes on the roadway include the connection to other limited-access highways, including I-95, US 29, I-370, and Shady Grove Road. Volumes to and from I-95 along the ICC are significant, at over 30,000 vehicles on an average weekday in FY 2014. A review of data for FY 2015 shows this connection to be the most important for the ICC as it continues to drive much of the growth on the ICC. Future development around this interchange will continue to push volumes on these ramps higher.

Trends in Method of Toll Payment

In the first year of operation, only 68.8 percent of ICC customers used E-ZPass®. This increased to a total of 84.9 percent system-wide by FY 2013. Between FY 2013 and FY 2016, E-ZPass® participation has decreased from 82.3 percent to 78.9 percent. However, this is not due to a shift of E-ZPass® customers to video tolling, since E-ZPass® transactions have increased every year since the opening of the ICC. Instead, the decrease in E-ZPass® participation is due to the faster growth of video transactions. This indicates that new users are more likely to use video tolling, a trend currently being observed at many other toll facilities offering video tolling across the nation. This may be the result of various different factors, such as video users increasing their trip frequency on the ICC, the addition of new users and more discretionary trips that (having seen marginal benefit in the past for their trip) are now seeing the ICC as an attractive option, the perceived time or expense of obtaining a transponder, or insufficient incentive (toll differential, time savings) to obtain a transponder. It should be noted that market share is relatively high at nearly 80 percent, but this trend of decreasing E-ZPass® share is something that MDTA should continue to monitor.

Stated Preference Surveys

A Stated Preference (SP) survey was developed and implemented that gathered information from 2,946 passenger-vehicle travelers who made trips in the ICC/MD 200 corridor in Maryland. Survey respondents represented a wide range of different trip purposes, household incomes, travel times, and geographies. The questionnaire collected data on current travel behavior, presented respondents with information about the ICC / MD 200 corridor, and engaged the travelers in a series of SP scenarios.

Overall, non-work-related trips (64 percent) were reported more frequently than work trips (36 percent), which implies that the corridor is commonly used for infrequent travel, but still supports a broad mixture of trip purposes throughout the week. Trip origins were shown to be spread throughout the study corridor, with many trips greater than 30 miles clustered around the western portion of the ICC corridor. Trip destinations were slightly more dispersed then trip origins, with many trips between 16–30 miles and greater than 30 miles ending northeast and southeast of the ICC corridor and in and around Baltimore. For all reported trips, the mean occupancy was 1.59 passengers, while the average trip frequency was 1.3 times per week.

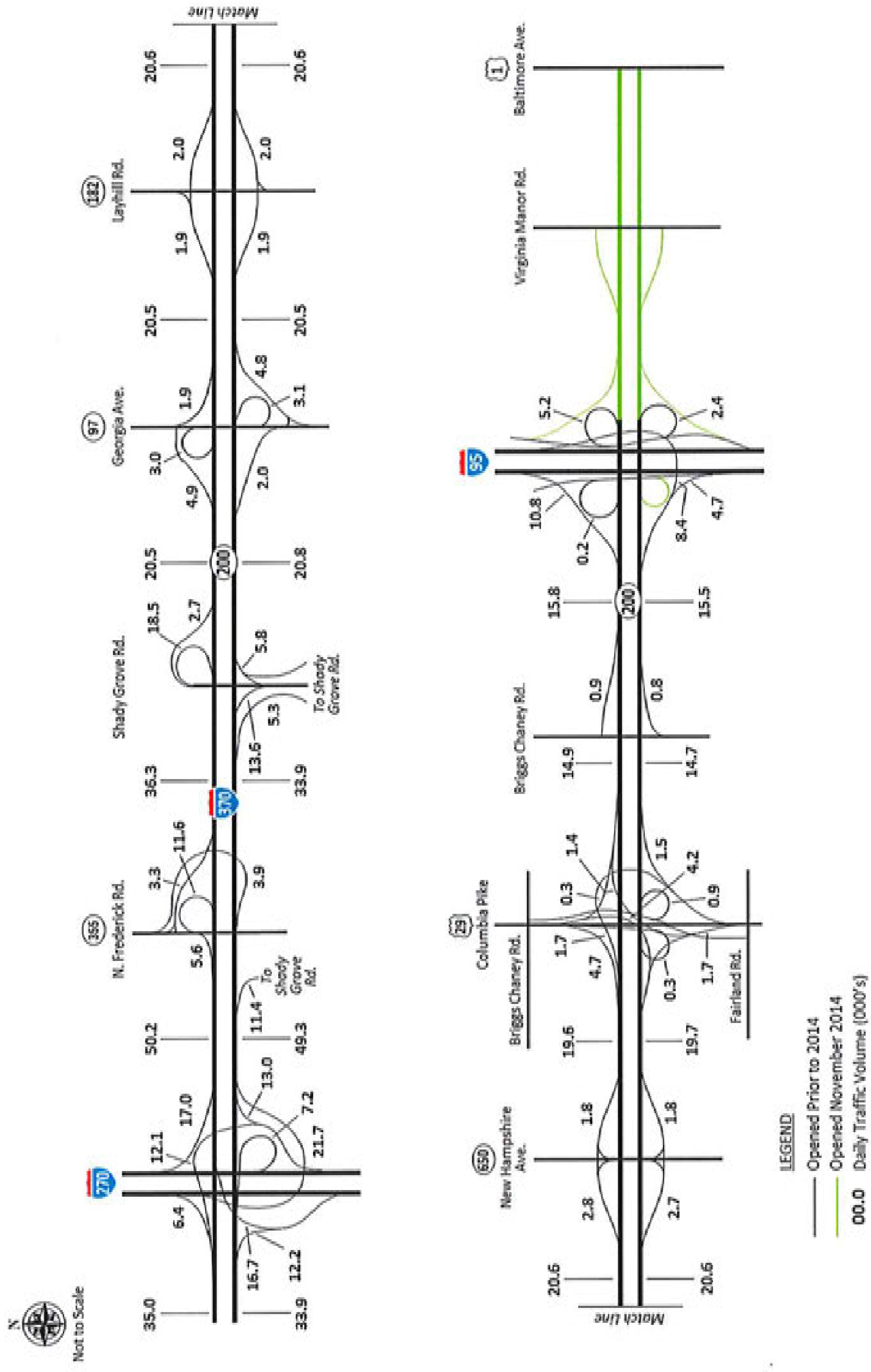


Figure ES-4
Balanced Profile of FY 2014 Average Annual Weekday Traffic Volumes on the Intercounty Connector

Although information on driver behavior and characteristics were collected as part of the survey, the primary purpose was to estimate the Value of Time (VOT) for passenger vehicle travelers in the region. This was done by using Multinomial Logit (MNL) choice models, which estimate VOT based on a series of individual toll and time savings options versus alternative route choices made by survey respondents. The magnitude and signs of the sensitivity estimates were considered reasonable and intuitively correct, and the VOT estimates that were developed were within the ranges found in other similar areas across the country. For ICC users, average VOT across different income groups for the market segments tested generally fell within a range of $8.00 per hour to $16.00 per hour, which is within the typical ranges found in the previous ICC SP survey and in other areas around the country where similar studies have been conducted. For potential ICC users, average VOT across different income groups varied from $6.00 per hour to $10.00 per hour. Ultimately, the VOT estimates were incorporated by CDM Smith into the travel demand model that was used to forecast traffic and toll revenue for the ICC.

Corridor Growth Assessment

Population and employment forecasts are a key input for developing trip generation estimates, which is the first step in building trip tables within the MWCOG travel demand model and ultimately estimating demand for the ICC corridor. Reviewing these forecasts as part of a corridor growth assessment is thus an important step, particularly within the context of the changing economic conditions experienced during the past several years. Adjustments to the base MWCOG forecasts were made by Renaissance Planning Group (RPG), who provided independent economic growth projections throughout the Washington, D.C., metropolitan area as part of this study. RPG's work especially focused on reviewing economic conditions and major development plans to make independent forecasts of population and employment in the Primary Market Area for the ICC.

One overarching trend in RPG's independent forecasts is that, compared to the base MWCOG forecasts, a lower number of jobs are predicted for the five counties closest to the ICC and for Washington, D.C. (referred to as the six Primary Jurisdictions). A steady lowering from the base MWCOG forecasts for employment is predicted, with a total of 142,000 fewer jobs in 2040. Another overarching trend is a higher population predicted in the Primary Jurisdictions compared to the base MWCOG forecasts, with 44,000 more residents by 2040. The notable exception to this trend is Washington, D.C. A continued increase in population is predicted in Washington, D.C., but growth is slowed notably from the rates projected in the base MWCOG forecasts. Finally, Montgomery County, which includes much of the Primary Market Area for ICC, is predicted to be best positioned to attract both residential and commercial growth of any of the Primary Jurisdictions.

Model Development

As part of this Comprehensive Traffic and Revenue Study, CDM Smith engaged in a substantial calibration effort of the MWCOG model, particularly on the ICC and the surrounding influence area. The model itself encompasses several counties in the Washington, D.C., and Baltimore metropolitan region, including Montgomery, Howard, Prince Georges, Anne Arundel, Frederick, and Baltimore counties as well as the District of Colombia. Before beginning the calibration process, adjustments were made to the base and future year model socioeconomic assumptions (population and employment data and forecasts) for the region. This modified socioeconomic dataset was then used in the MWCOG model to produce revised trip tables.

The calibration process consisted of the refinement and adjustment of the model roadway network, trip tables, and toll assignment inputs. CDM Smith conducted a detailed review of network attributes in the ICC region of the MWCOG model and made adjustments as necessary to reflect FY 2014 roadway conditions and the improvements made to the ICC and I-95 in FY 2015. Lastly, VOT and Vehicle Operating Cost (VOC) values were adjusted during the calibration process. Overall, the model speeds, diversion, traffic volumes, and specific ICC patterns output by the modified model were close to the observed data for FY 2014. Through validation against base year conditions, the network characteristics of the ICC corridor and surrounding area matched existing conditions.

Toll Reduction Analysis

Under the forecast assumptions, only one toll change was assumed during the forecast period and that was the toll decrease implemented on July 1, 2015. Under this decrease, per-mile toll rates on the ICC were reduced by $0.03 per mile across all time periods. This resulted in a per-mile toll rate decrease from $0.25 to $0.22 during the Peak Period, from $0.20 to $0.17 during the Off-Peak Period, and from $0.10 to $0.07 during the Overnight Period. Based on monthly data before and after the toll decrease, the estimated average impact of the toll rate decrease across the ICC was a 3.7 percent increase in toll transactions. This was roughly the same across all toll gantries, with the exception of the I13/I14 gantries, which are between US 29 and I-95, where the estimated impacts were 4.6 percent. Based on an approximate percent toll rate decrease of 15 percent, the estimated toll elasticity of the ICC is -0.249. This is a relatively low elasticity for a corridor toll road, implying that the toll rates that were in place prior to the toll decrease were in a reasonable and appropriate range and confirming the value being placed by users on the ICC.

Estimated Average Weekday Traffic Volumes

AAWDT volumes for the ICC are presented in **Figure ES-5** for forecast years FY 2023, FY 2030 and FY 2040. The estimates incorporate all of the analyses and assumptions described in this report. The estimated traffic volumes reflect the toll structure that was put in place on July 1, 2015, with no toll increases assumed.

The four tolling segments of the ICC between I-370 and US 29 carry similar traffic volumes through all the forecast years. Estimated traffic volumes in FY 2023 on the ICC between I-370 and US 29 range between 59,200 and 61,400 for an average weekday. This is estimated to increase to between 67,400 and 70,200 vehicles per average weekday in FY 2030, and between 76,800 and 81,800 vehicles in FY 2040. This represents estimated average annual growth rates of 2.0 percent between FY 2023 and FY 2030 and 1.3 percent between FY 2030 and FY 2040.

On the new ICC Extension to US 1, which opened to traffic in November 2014, an average weekday traffic volume of 14,200 vehicles is estimated in FY 2023 at the mainline toll gantry. As a result of ramp-up and economic developments in this area, AAWDT volumes are estimated to increase by an average of 4.2 percent per year to 19,000 vehicles in FY 2030. Traffic growth on this segment is then estimated to slow to rates consistent with the rest of the ICC between FY 2030 and FY 2040. An estimated 22,200 vehicles are estimated for the average weekday in FY 2040, representing an average annual increase over FY 2030 of 1.5 percent.

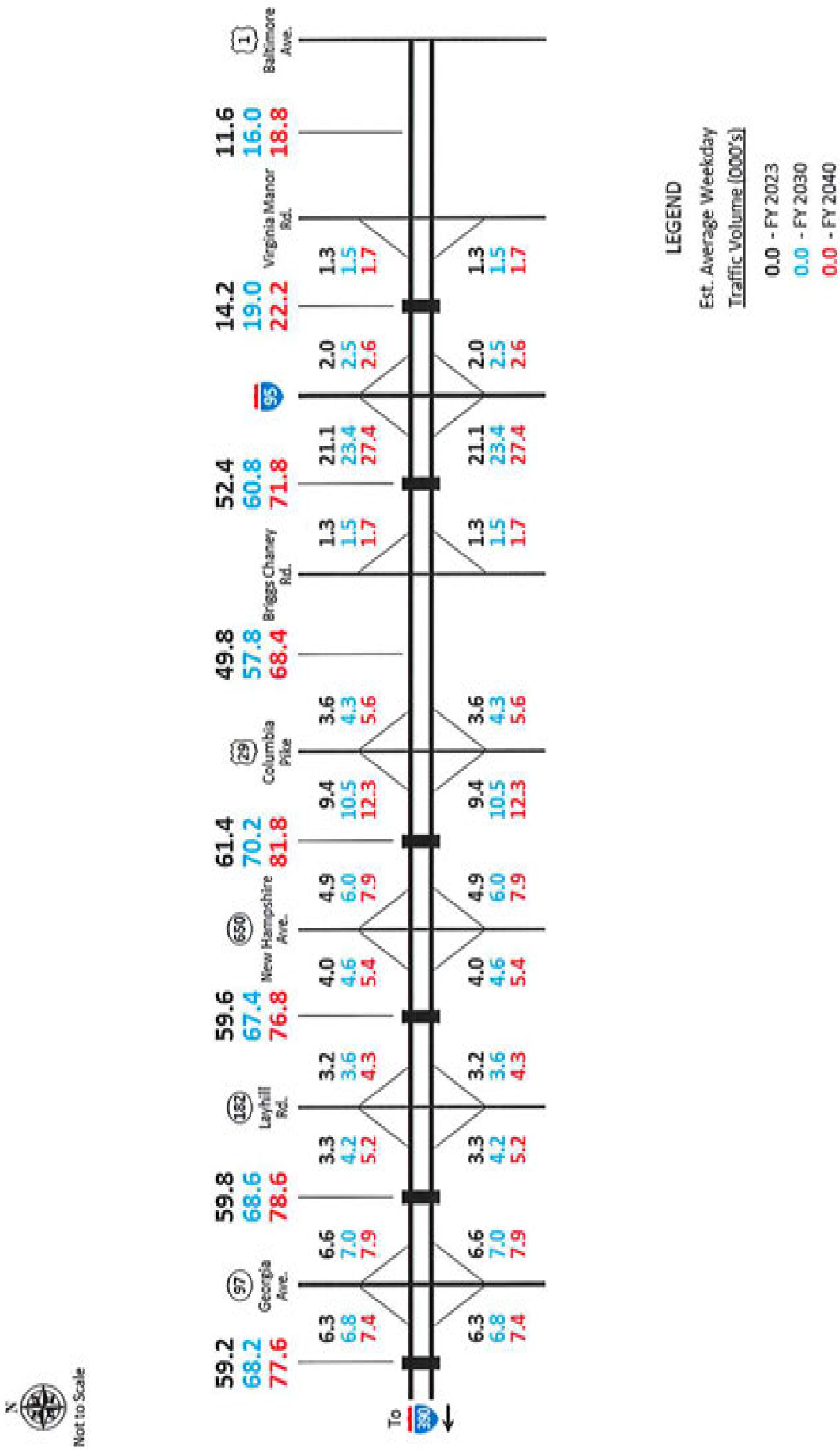


Figure ES-5

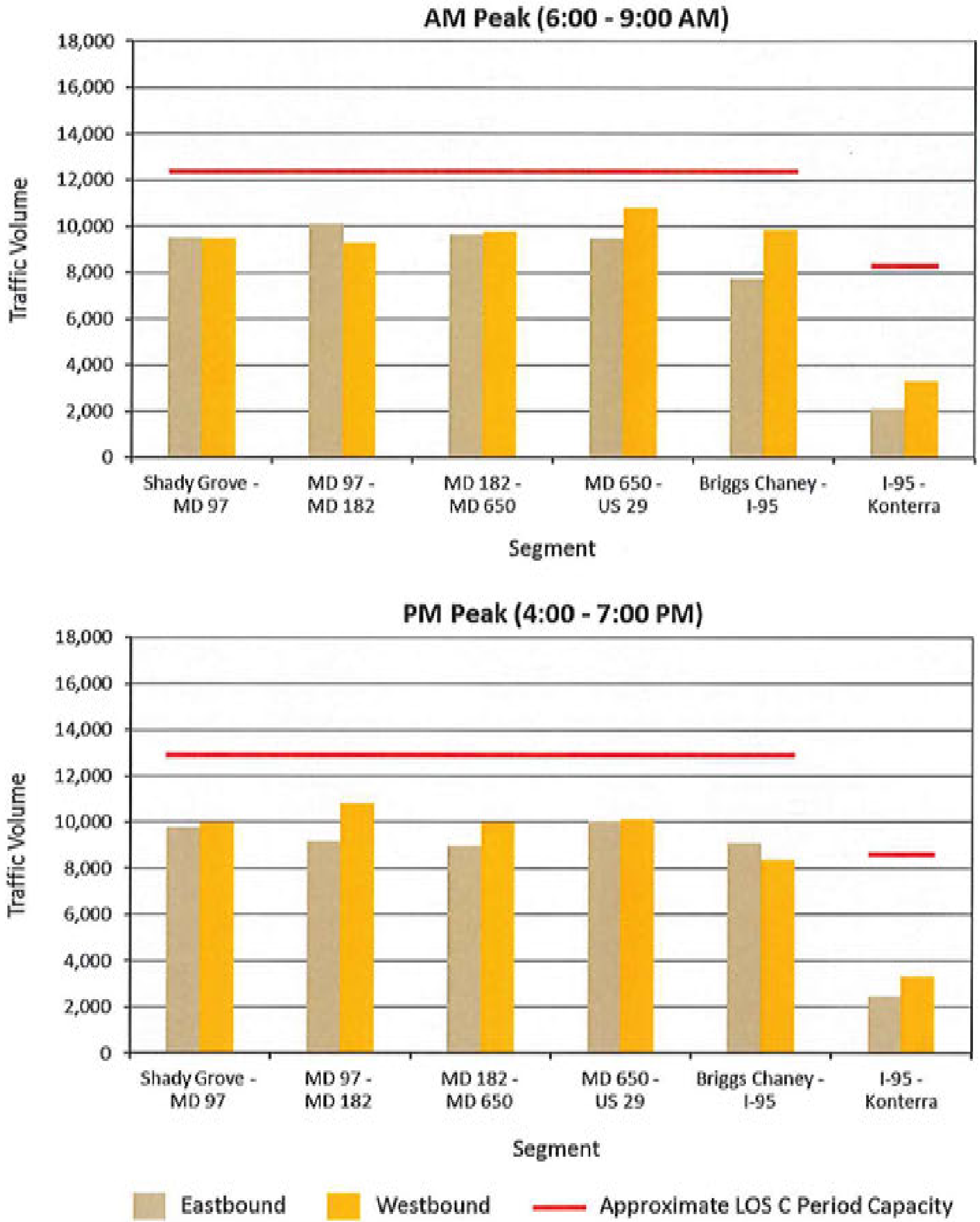
Estimated Average Weekday Traffic Volumes on the Intercounty Connector

One consideration for the future-year traffic volumes was whether or not travel demand would exceed a theoretical "Level of Service C" capacity on any segment of the ICC. Although MDTA has not determined what Level of Service threshold might trigger congestion-managed toll increases, for the purposes of this analysis it was assumed that "Level of Service C" represented that threshold. **Figure ES-6** illustrates the relationship between the theoretical "Level of Service C" peak period capacity and the estimated FY 2040 volumes during the AM Peak (6:00 – 9:00 AM) and PM Peak (4:00 – 7:00 PM) Periods on the ICC by segment and direction. As is shown in the figure, FY 2040 estimated average Peak Period volumes on the ICC range between 8,000 and 10,000 vehicles during both the AM and PM Peak Periods west of I-95. This is roughly 2,500 vehicles less than the theoretical "Level of Service C" capacity for these segments. Similarly, the new ICC Extension to US 1 is estimated to carry between 2,000 and 4,000 vehicles during both the AM and PM Peak Periods, which is more than 4,000 vehicles less than the theoretical "Level of Service C" capacity. Based on this analysis, no toll increases would be required to maintain "Level of Service C" travel conditions through the forecast period. This analysis is based on estimated annual average daily traffic volumes. While specific hourly traffic volumes will vary by day and time of year, average traffic volumes on the ICC are estimated to be less than the estimated "Level of Service C," as noted above.

Annual Trips and Toll Revenue Forecast

Estimates of annual toll revenue for the ICC through FY 2040 are presented in **Table ES-2**. Actual data between FY 2011 and FY 2015 are also provided for comparative purposes. The FY 2016 estimates incorporate the observed impacts of the July 1, 2015 toll rate decrease estimated based on data through September 2015. These impacts are carried forward through the forecast period. Short-term annual trip and toll revenue forecasts are based on a review of historical trends and growth rates estimated through the modeling process. Interim-year trip and toll revenue forecasts were then developed through interpolation between the model years. **Table ES-2** provides estimates of collected toll revenue, which represents revenue that is estimated to be actually collected by MDTA after assumed reductions due to unbillable and unpaid transactions and other revenue leakage issues. Leakage rates were assumed to be constant throughout the forecast period, with 98.5 percent of ETC toll revenue collected and 76.2 percent of video toll revenue collected.

Short-term annual trip and collected toll revenue forecasts are based on a review of historical trends and growth rates estimated through the modeling process between FY 2015 and FY 2023. A 14.0 percent increase in trips to 27.5 million and a 1.6 percent increase in collected toll revenues to $56.9 million is estimated for the first forecast year, FY 2016, as compared to FY 2015. These increases in trips and toll revenue are impacted by the July 1, 2015 toll rate decrease. CDM Smith estimates that "normal growth" in trips, excluding the toll rate decrease, would produce a 10.2 percent increase in trips and a 10.5 percent increase in toll revenue. This indicates that the toll rate decrease is estimated to produce a 3.8 percent increase in trips and an estimated 8.9 percent decrease in toll revenue. Trips in FY 2017 are estimated to increase by 5.0 percent over FY 2016 to 28.8 million. Collected toll revenues in FY 2017 are estimated to increase by 5.3 percent over FY 2016 to $59.9 million.



Note: Although MDTA has not determined what Level of Service threshold might trigger congestion managed toll increases, for purposes of this analysis, it is assumed that "Level of Service C" would not be exceeded.

Figure ES-6
FY 2040 Estimated AM and PM Period Segment Volumes by Mainline Segment and Direction

Table ES-2
Estimated Annual Trips and Toll Revenue

Fiscal Year	Peak / Off Peak / Overnight Per Mile Toll Rate	Estimated Annual Trips (000s): ETC Trips	ETC AAPC [2]	ETC Percent ETC	Video Trips	Video AAPC [2]	Total Trips	Total AAPC [2]	Estimated Collected Revenue ($000s) [1]: ETC Toll Revenue	ETC Percent Collected [3]	ETC Average Toll	Video Toll Revenue	Video Percent Collected [3]	Video Average Toll	Total Toll Revenue	Total Percent Collected [3]	Total Average Toll
2011 [4]	$0.25 / $0.20 / $0.10	1,639		74.7	554		2,193		$ 1,434	98.5	$ 0.87	$ 40	76.2	$ 0.07	$ 1,474	97.7	$ 0.67
2012 [4]	$0.25 / $0.20 / $0.10	9,413	474.3	93.7	630	13.7	10,043	358.0	18,062	98.5	1.92	1,671	76.2	2.65	19,733	96.1	1.96
2013 [4]	$0.25 / $0.20 / $0.10	15,683	66.6	91.2	1,515	140.5	17,198	71.2	34,696	98.5	2.21	4,891	76.2	3.23	39,587	95.1	2.30
2014 [4]	$0.25 / $0.20 / $0.10	18,356	17.0	89.6	2,120	39.9	20,476	19.1	40,924	98.5	2.23	7,104	76.2	3.35	48,028	94.4	2.35
2015 [4]	$0.25 / $0.20 / $0.10	21,598	17.7	89.6	2,520	18.9	24,118	17.8	47,705	98.5	2.21	8,313	76.2	3.30	56,018	94.4	2.32
2016 [5]	$0.22 / $0.17 / $0.07	24,534	13.6	89.2	2,971	17.9	27,505	14.0	47,985	98.5	1.96	8,926	76.2	3.00	56,911	94.2	2.07
2017	$0.22 / $0.17 / $0.07	25,727	4.9	89.1	3,148	6.0	28,875	5.0	50,408	98.5	1.96	9,486	76.2	3.01	59,894	94.1	2.07
2018	$0.22 / $0.17 / $0.07	26,360	2.5	89.0	3,260	3.6	29,620	2.6	51,741	98.5	1.96	9,849	76.2	3.02	61,590	94.1	2.08
2019	$0.22 / $0.17 / $0.07	26,906	2.1	88.9	3,363	3.2	30,269	2.2	52,910	98.5	1.97	10,188	76.2	3.03	63,098	94.1	2.08
2020	$0.22 / $0.17 / $0.07	27,464	2.1	88.8	3,469	3.2	30,933	2.2	54,104	98.5	1.97	10,538	76.2	3.04	64,642	94.0	2.09
2021	$0.22 / $0.17 / $0.07	28,034	2.1	88.7	3,578	3.1	31,612	2.2	55,325	98.5	1.97	10,901	76.2	3.05	66,226	94.0	2.09
2022	$0.22 / $0.17 / $0.07	28,615	2.1	88.6	3,691	3.2	32,306	2.2	56,574	98.5	1.98	11,276	76.2	3.05	67,850	93.9	2.10
2023	$0.22 / $0.17 / $0.07	29,208	2.1	88.5	3,807	3.1	33,015	2.2	57,851	98.5	1.98	11,664	76.2	3.06	69,515	93.9	2.11
2024	$0.22 / $0.17 / $0.07	29,768	1.9	88.4	3,903	2.5	33,671	2.0	59,047	98.5	1.98	11,970	76.2	3.07	71,017	93.9	2.11
2025	$0.22 / $0.17 / $0.07	30,339	1.9	88.3	4,001	2.5	34,340	2.0	60,268	98.5	1.99	12,285	76.2	3.07	72,553	93.8	2.11
2026	$0.22 / $0.17 / $0.07	30,921	1.9	88.3	4,101	2.5	35,022	2.0	61,513	98.5	1.99	12,608	76.2	3.07	74,121	93.8	2.12
2027	$0.22 / $0.17 / $0.07	31,514	1.9	88.2	4,204	2.5	35,718	2.0	62,785	98.5	1.99	12,940	76.2	3.08	75,725	93.8	2.12
2028	$0.22 / $0.17 / $0.07	32,119	1.9	88.2	4,309	2.5	36,428	2.0	64,062	98.5	2.00	13,280	76.2	3.08	77,382	93.8	2.12
2029	$0.22 / $0.17 / $0.07	32,735	1.9	88.1	4,417	2.5	37,152	2.0	65,407	98.5	2.00	13,629	76.2	3.09	79,036	93.8	2.13
2030	$0.22 / $0.17 / $0.07	33,363	1.9	88.1	4,527	2.5	37,890	2.0	66,759	98.5	2.00	13,987	76.2	3.09	80,746	93.7	2.13
2031	$0.22 / $0.17 / $0.07	33,850	1.5	88.0	4,622	2.1	38,472	1.5	67,698	98.5	2.00	14,269	76.2	3.09	81,967	93.7	2.13
2032	$0.22 / $0.17 / $0.07	34,345	1.5	87.9	4,718	2.1	39,063	1.5	68,650	98.5	2.00	14,557	76.2	3.09	83,207	93.7	2.13
2033	$0.22 / $0.17 / $0.07	34,847	1.5	87.9	4,817	2.1	39,664	1.5	69,616	98.5	2.00	14,851	76.2	3.08	84,467	93.7	2.13
2034	$0.22 / $0.17 / $0.07	35,356	1.5	87.8	4,917	2.1	40,273	1.5	70,596	98.5	2.00	15,150	76.2	3.08	85,746	93.7	2.13
2035	$0.22 / $0.17 / $0.07	35,873	1.5	87.7	5,020	2.1	40,893	1.5	71,589	98.5	2.00	15,456	76.2	3.08	87,045	93.6	2.13
2036	$0.22 / $0.17 / $0.07	36,398	1.5	87.7	5,125	2.1	41,523	1.5	72,596	98.5	1.99	15,767	76.2	3.08	88,363	93.6	2.13
2037	$0.22 / $0.17 / $0.07	36,929	1.5	87.6	5,232	2.1	42,161	1.5	73,617	98.5	1.99	16,085	76.2	3.07	89,702	93.6	2.13
2038	$0.22 / $0.17 / $0.07	37,469	1.5	87.5	5,341	2.1	42,810	1.5	74,653	98.5	1.99	16,410	76.2	3.07	91,063	93.6	2.13
2039	$0.22 / $0.17 / $0.07	38,017	1.5	87.5	5,452	2.1	43,469	1.5	75,703	98.5	1.99	16,741	76.2	3.07	92,444	93.5	2.13
2040	$0.22 / $0.17 / $0.07	38,573	1.5	87.4	5,586	2.1	44,139	1.5	76,768	98.5	1.99	17,079	76.2	3.07	93,847	93.5	2.13

(1) Includes revenue impacts due to leakage, including unpaid transactions.
(2) Average Annual Percent Change.
(3) Percent of Gross Toll Revenue collected after including revenue impacts due to leakage.
(4) Actual, also indicated with blue shading.
(5) FY 2016 full year estimates incorporate actual data through September 2015.

Chapter 1

Introduction

Under contract to the Maryland Transportation Authority (MDTA), CDM Smith conducted a new comprehensive traffic and revenue study for MD 200 / Intercounty Connector (ICC) operated by the MDTA. The purpose of the study was to provide a new traffic and revenue forecast for the ICC which is now in its sixth year of operation. The most recent Metropolitan Washington Council of Governments (MWCOG) regional travel demand model was utilized along with refined socioeconomic data and forecasts for the region and specifically for the primary market area of the ICC. The model and forecast were benchmarked to current traffic and operating characteristics on the ICC and the surrounding roadway network. The latest information on future roadway improvement assumptions was assembled and included in the model. The calibrated and refined travel demand model was then utilized to develop traffic and revenue forecasts for the ICC through FY 2050. This report summarizes the study effort, including historical traffic and revenue trends on the ICC, summaries of the traffic counts and travel speeds of the surrounding and competing facilities, historical and future socioeconomic forecasts, the modeling methodology, and the transaction and revenue forecast.

1.1 Study Purpose

The last comprehensive traffic and revenue study of the ICC was conducted by CDM Smith in November 2009. The 2009 study updated the assumptions of the future land use forecasts, timing of roadway improvements, ICC opening dates, and other modeling inputs included in the original June 2006 comprehensive study. Since that time, the ICC has opened six tolled segments in three phases between I-370 and US 1. Additional study efforts have been conducted for the MDTA by CDM Smith since 2009, such as providing traffic and revenue estimates based on different toll rates, surcharge amounts, opening dates, and more. Although the efforts included changes to various assumptions regarding project schedules and toll rates, the forecasts relied upon the same socioeconomic and travel pattern assumptions included in the 2006 and 2009 studies, which are now outdated due to impact of the "great recession" and high unemployment levels that have remained years later.

The purpose of this new comprehensive study is to provide a fully updated traffic and revenue forecast using the latest socioeconomic data, updated traffic count and travel time data, the latest regional motorist origin and destination points and travel pattern data, updated value of time estimates based on a new stated preference survey, and an updated regional weekday travel demand model incorporating the latest highway improvement program. The study makes maximum use of all available data for the ICC, including historical traffic volume trend information by vehicle category and toll payment category. The analysis also includes a general overview of economic trends, both nationally and within the region. The "Base Case" traffic and revenue estimates that are presented in this document have been prepared using assumptions considered to reflect the most reasonable and likely conditions in the future. The estimates of traffic and revenue for the ICC through FY 2050 have been developed at a level of detail suitable to be used by MDTA in support of bond financing, if desired.

1.2 ICC Description

MDTA currently operates nine toll facilities across the State of Maryland. The ICC opened to traffic in 2011 as the eighth MDTA toll facility and the first all-electronic toll road in Maryland. As shown in **Figure 1-1**, the ICC is an east-west limited access facility located in the Washington, D.C., / Baltimore, MD metropolitan area. It connects I-370 in the Gaithersburg, MD area to I-95 and US 1 in Laurel, MD. The ICC is primarily three-lanes per direction with a posted speed limit of 60 MPH between I-370 and US 29 and 55 MPH between US 29 and US 1.

Figure 1-2 illustrates the existing configuration of the ICC and indicates the location of interchanges and toll gantries. The first segment of the ICC opened on February 23, 2011 and extended 5.65 miles from the end of I-370 at Shady Grove Road to MD 97 / Georgia Avenue. The second segment of the ICC, between MD 97 / Georgia Avenue and I-95 was opened to traffic on November 22, 2011. This segment represents the majority of the ICC, with a distance of 10.35 miles. The final segment of the ICC opened on November 9, 2014 between I-95 and US 1, with a distance of 1.53 miles. In total, the ICC extends 17.53 miles between I-370 and US 1. There are currently six toll gantries per direction that cover movements between nine interchanges, as shown in **Table 1-1**.

Tolls on the ICC are assessed based on the particular interchange-to-interchange movement, as shown in **Table 1-2**. Tolls range from $0.40 to $3.86 for E-ZPass® customers depending on the length of the trip. Higher tolls are assessed on weekdays during Peak Period hours (6:00 – 9:00 AM and 4:00 – 7:00 PM) than during Overnight hours (11:00 PM – 5:00 AM) or Off-Peak Period hours (all other hours). On the weekends, tolls also differ between Overnight hours (11:00 PM – 5:00 AM) and Off-Peak Period hours (5:00 AM – 11:00 PM).

Tolls are collected using an All-Electronic Toll (AET) system, through the use of an E-ZPass® transponder. Instead of toll plazas, tolls are collected on the ICC using sensors and cameras mounted on overhead gantries. For those customers without an E-ZPass® transponder, a video image of the customer's license plate is taken and the customer is then mailed a bill. In order to encourage E-ZPass® usage and offset the additional processing costs associated with video tolling, toll rates for customers using video tolling are 50 percent more than for those using E-ZPass®, with a minimum difference of $1.00 and a maximum difference of $15.00. Toll rates are greater for commercial vehicles based on the number of axles.

1.3 Report Structure

Chapter 2, **Historical Traffic and Revenue Trends**, provides a summary of the historical trends and variations of traffic and toll revenue on the ICC. Included in this summary are historical regional traffic volumes, monthly ICC transactions and toll revenue, a balanced traffic profile and interchange-to-interchange movements for the ICC, a summary of historical E-ZPass® market share, regional travel times and speeds and other relevant historical data. Traffic counts and travel speeds and times are also presented for other roadway facilities in the study area.

Chapter 3, **Stated Preference Survey**, presents a summary of the stated preference survey conducted in the study corridor as part of this study. A copy of the technical details of the survey, along with survey tabulations, is included in **Appendix A**.

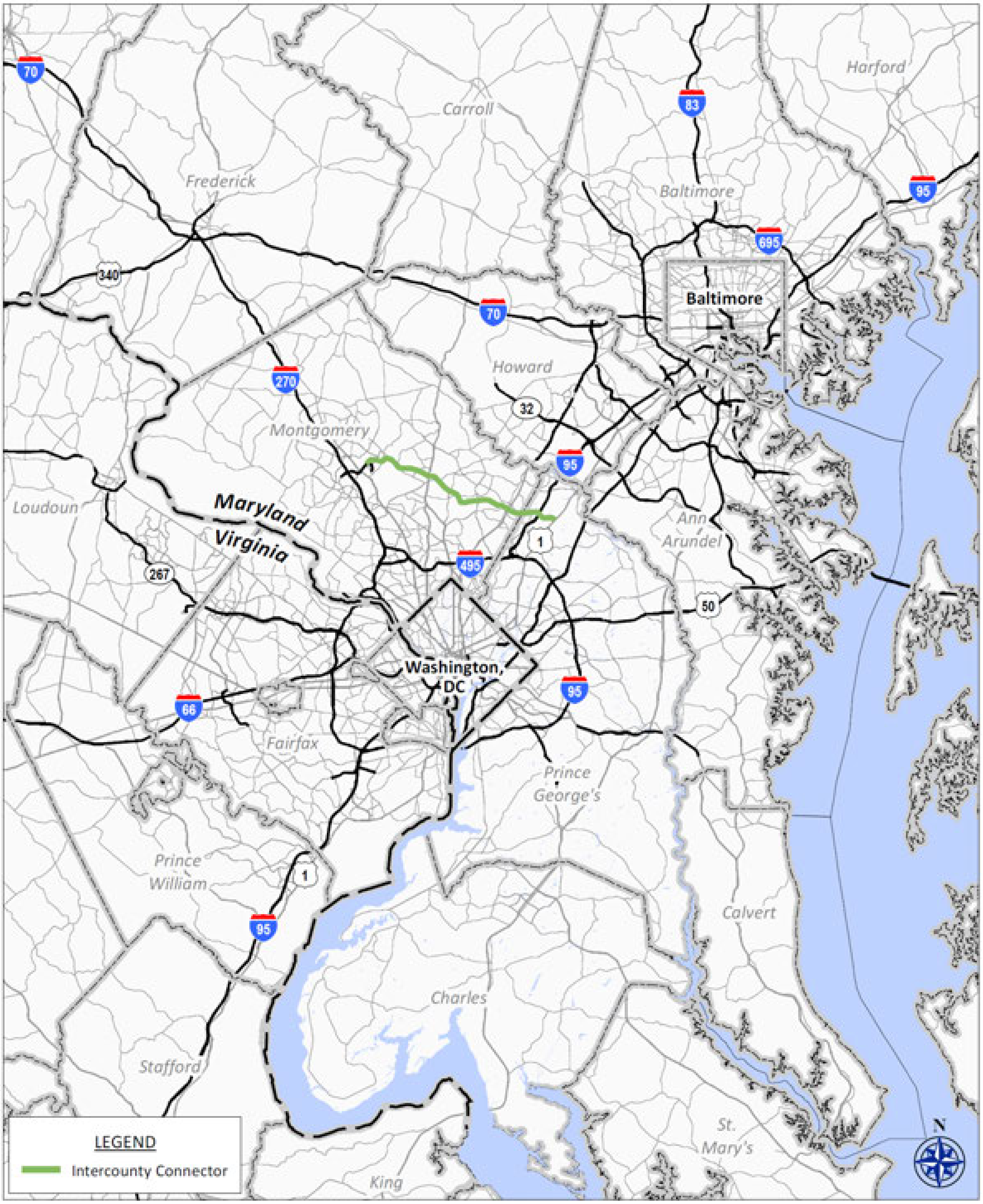


Figure 1-1
Regional Area Map

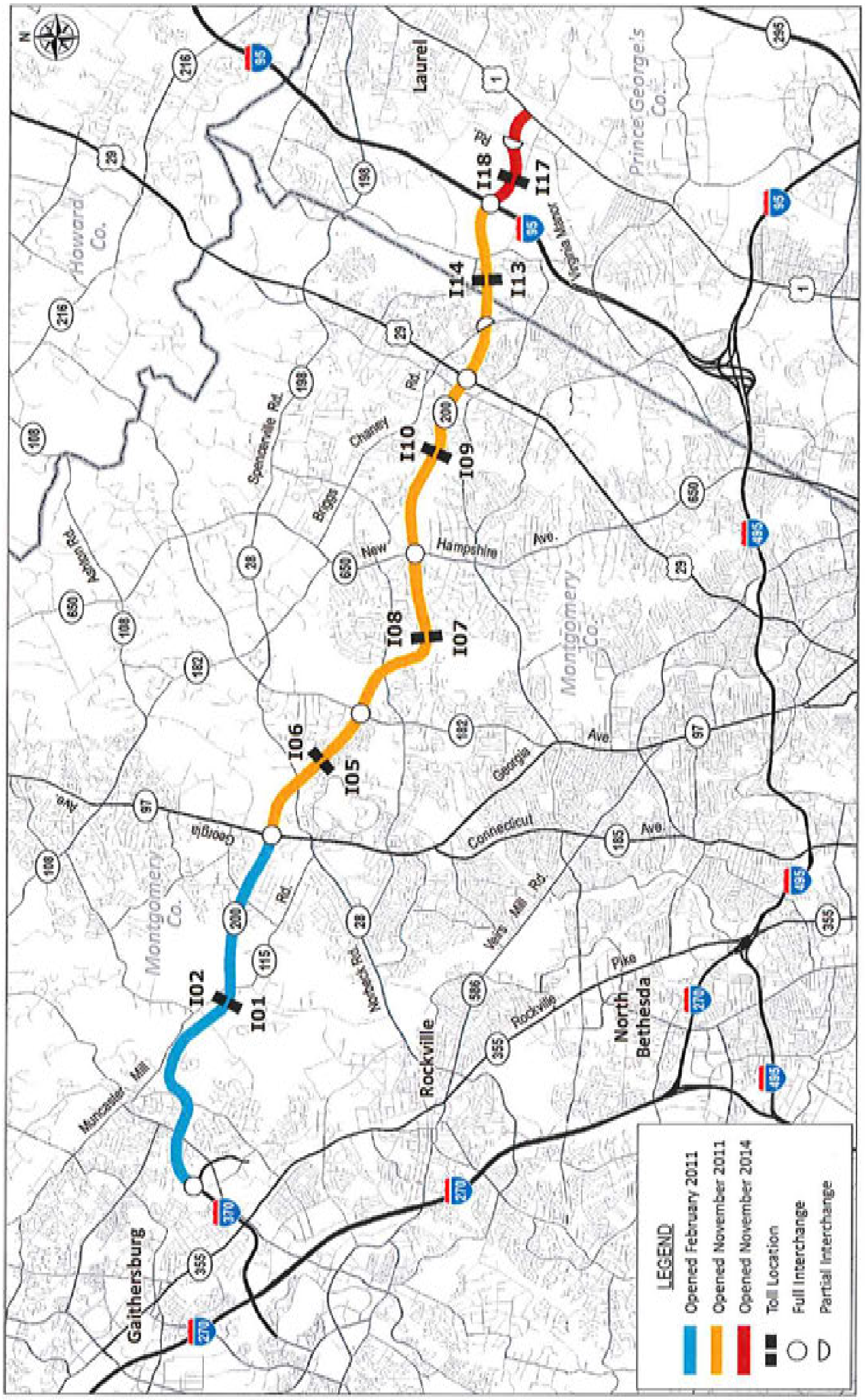


Figure 1-2
Intercounty Connector Location Map

Chapter 4, **Economic and Demographic Review**, presents a summary of the independent economist's review of the reasonableness of the socioeconomic and demographic forecasts used in the study. It is noted that the full report of the independent economic consultant is included in Appendix B to this report; and

Chapter 5, **Model Development and Calibration**, describes the development of the traffic forecast model, calibration results, and assumed roadway improvements.

Chapter 6, **Traffic and Revenue Forecast**, describes the underlying basic assumptions used in the traffic and revenue forecasting, discusses an analysis of overall toll elasticity of the ICC users based on data since the July 1, 2015 toll reduction, and finally presents monthly and annual forecasts of traffic and toll revenue for the ICC.

Chapter 2

Traffic and Revenue Trends

Chapter 2 provides a detailed analysis of historical operating trends on the existing MD 200 / Intercounty Connector (ICC) Expressway. This includes annual and monthly transaction and toll revenue trends, changes in the market share between E-ZPass® and video customers, and an evaluation of transaction distribution by vehicle class and method of payment. Average daily and weekday volume trends and hourly variation data have also assessed. This analysis serves as the basis for benchmarking our analysis to actual usage and patterns on the ICC, providing calibration targets for modeling, and serving as a basis for estimating short-term traffic growth for the ICC.

Throughout this report the terms "transactions", "trips" and "traffic" are referenced. There is a significant difference between these terms. A transaction occurs when a vehicle passes underneath a toll gantry. A trip refers to a movement from one access point to one egress point along the ICC. By these definitions, a trip could generate many transactions. Traffic refers to the volume of vehicles on any particular link. It should be noted that the use of these terms in this report is precise, in that they are purposefully used wherever they have been specifically referenced.

2.1 Historical Transaction and Revenue Trends

Monthly transaction and revenue data are available for the entire length of the ICC and can be found in **Tables 2-1 and 2-2**, respectively. In order to consider historical traffic growth by ICC segment, CDM Smith utilized transaction data in the analysis of historical trends. The transaction and toll revenue data presented ranges from February 2011, when the first segment of the ICC opened, to September 2015.

The roughly 5.5 mile segment from I-370 to MD-97 / Georgia Avenue was the only portion open from February to November 2011. Between February 23, 2011 and March 7, 2011, this segment operated toll free. E-ZPass® toll operation began March 7, 2011 and video toll operations began April 6, 2011. During the initial nine-month period when this segment was first opened, a total of over 3 million vehicles used the ICC, with a monthly high of 352,666 in May 2011, the first full month of toll operation.

The second segment of the ICC opened from MD-97 / Georgia Avenue to I-95 on November 22, 2011. This segment was operated toll free until December 5, 2011. By January 2012, the first full month of toll operation, a total of 2,999,797 transactions were recorded for the ICC system as a whole.

Transactions increased by a total of 84 percent from FY 2012 to FY 2013 and 20 percent from FY 2013 to FY 2014 system-wide. This was due primarily to both the opening of the second segment of the ICC in November 2011 and to the phenomenon of facility "ramp-up," where motorists adjust their travel patterns over time as they become aware of a new facility and the benefits that it offers over their current route of travel. This ramp-up period continued into FY 2015, with a 19.1 percent growth in transactions and an 18.4 percent growth in toll revenue. Transactions in FY 2016 grew at a faster rate than FY 2015, due primarily to the toll reduction implemented in July 2015. This was also reflected in the lower revenues in FY 2016, comparing the first three months to the same period during the prior year. **Figure 2-1** shows the progression of total transactions and toll revenue on the ICC.

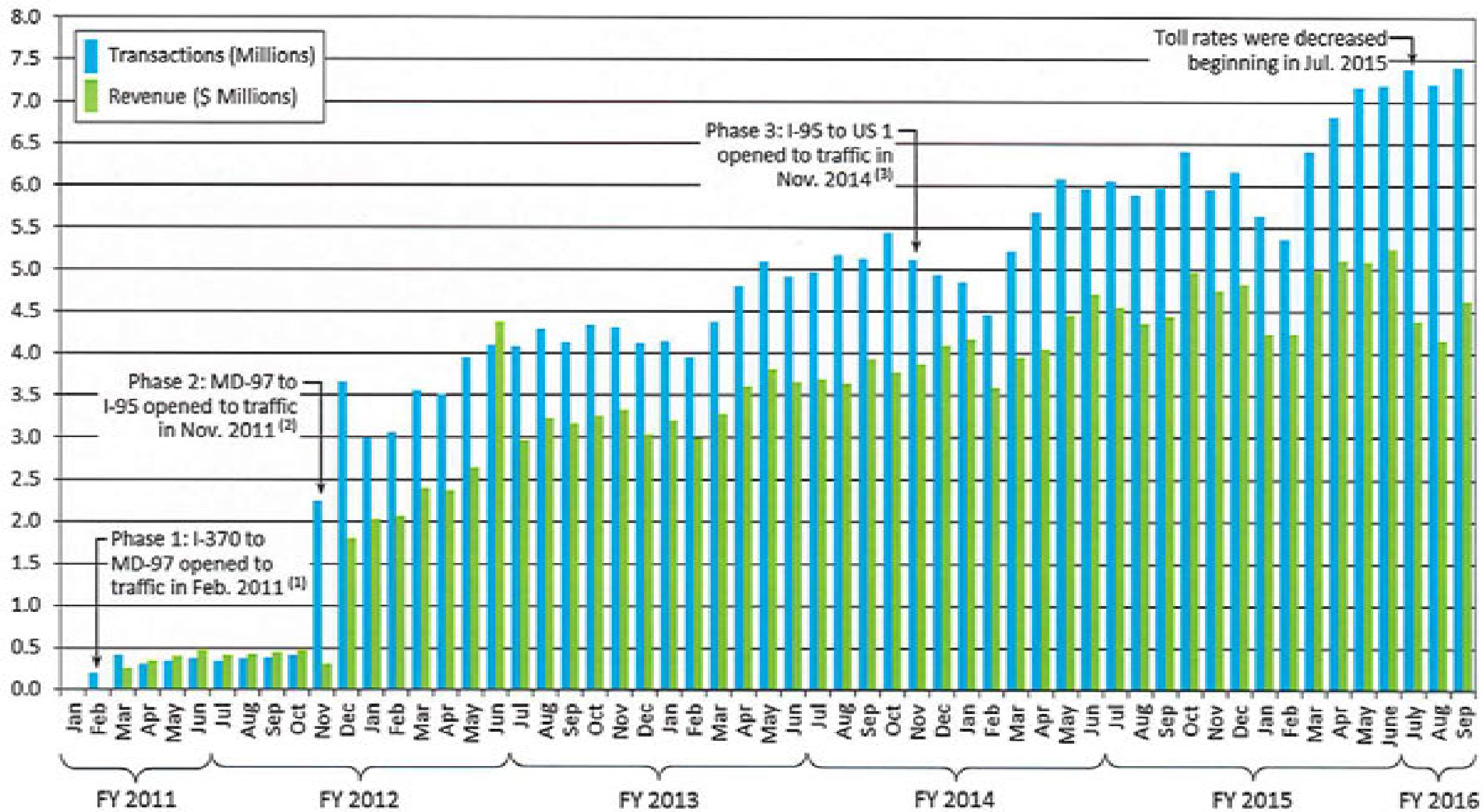
Table 2-1
Monthly System-wide Toll Transaction Trends
FY 2011 – FY 2016

Month	FY 2011 [1]	Percent Change	FY 2012 [2]	Percent Change	FY 2013	Percent Change	FY 2014	Percent Change	FY 2015 [3]	Percent Change	FY 2016 [4][5]
July	-	-	334,709	1051.7	4,083,069	21.6	4,968,063	22.0	6,039,283	22.0	7,393,323
August	-	-	369,438	1061.6	4,291,530	20.5	5,172,549	14.1	5,899,486	22.2	7,207,909
September	-	-	385,184	973.5	4,142,846	23.9	5,134,767	16.6	5,987,273	23.8	7,412,760
October	-	-	409,338	900.1	4,339,517	25.6	5,449,704	17.5	6,405,597	-	-
November	-	-	2,242,613	92.6	4,319,303	18.8	5,129,634	16.1	5,956,146	-	-
December	-	-	3,665,085	12.5	4,124,912	19.8	4,940,797	25.1	6,179,337	-	-
January	-	-	2,999,797	38.6	4,156,651	16.7	4,850,107	16.4	5,647,160	-	-
February	189,536	1517.7	3,066,507	29.1	3,959,310	13.1	4,478,360	20.0	5,375,124	-	-
March	413,096	763.0	3,564,722	22.9	4,381,800	19.2	5,229,840	22.5	6,399,917	-	-
April	309,993	1034.2	3,515,991	36.8	4,811,301	18.2	5,683,337	20.1	6,829,125	-	-
May	352,666	1023.6	3,962,663	28.7	5,101,247	19.3	6,083,490	18.0	7,179,475	-	-
June	376,182	990.2	4,101,215	19.9	4,915,597	21.6	5,976,215	20.6	7,204,505	-	-
Total	1,641,473	1644.6	28,637,264	83.8	52,629,083	19.9	63,092,883	19.1	75,120,432	22.7	22,014,194

Table 2-2
Monthly System-wide Toll Revenue Trends
FY 2011 – FY 2016

Month	FY 2011 [1]	Percent Change	FY 2012 [2]	Percent Change	FY 2013	Percent Change	FY 2014	Percent Change	FY 2015 [3]	Percent Change	FY 2016 [4][5]
July	$ -	-	$ 410,482	625.7	$ 2,978,742	24.2	$ 3,699,627	23.3	$ 4,559,966	(3.7)	$ 4,389,381
August	-	-	422,735	664.4	3,231,268	13.1	3,655,486	19.7	4,375,893	(4.8)	4,164,470
September	-	-	446,834	609.3	3,169,578	24.2	3,935,482	13.0	4,447,190	4.0	4,625,592
October	-	-	472,713	587.8	3,251,361	16.4	3,784,073	31.2	4,965,811	-	-
November	-	-	314,796	956.9	3,327,037	16.8	3,885,860	22.2	4,748,405	-	-
December	-	-	1,794,065	69.4	3,038,624	34.8	4,096,985	18.0	4,833,789	-	-
January	-	-	2,020,378	58.8	3,208,521	30.1	4,175,884	1.6	4,241,213	-	-
February	-	-	2,064,501	45.3	2,998,935	20.3	3,607,784	17.6	4,243,160	-	-
March	258,190	836.7	2,392,567	37.1	3,280,138	20.5	3,954,160	26.0	4,982,470	-	-
April	345,580	585.1	2,367,500	52.8	3,617,514	12.3	4,063,714	25.7	5,106,478	-	-
May	396,222	568.0	2,646,582	44.1	3,814,984	16.9	4,458,570	14.5	5,103,864	-	-
June	474,133	825.8	4,379,869	(16.2)	3,669,559	28.4	4,711,332	11.6	5,255,811	-	-
Total	$ 1,474,125	1238.6	$ 19,733,024	100.6	$ 39,586,280	21.3	$ 48,028,779	18.4	$ 56,864,030	(1.5)	$ 13,179,442

(1) The segment between I-370 and MD 97 (location of Toll Gantries 101/102) opened on February 23, 2011 and was the only segment open in FY 2011.
The segment operated toll free until the beginning of E-ZPass® toll operations on March 7, 2011 and the beginning of video toll operations on April 6, 2011.
(2) Toll Gantries 105/106, 107/108, 109/110, and 113/114 opened in November22, 2011 (FY 2012). Toll operations began December 5, 2011.
(3) Toll Gantries 117/118 opened November 10, 2014 (FY 2015).
(4) Toll Rates were decreased effective July 2015 (FY 2016).
(5) FY 2016 data includes data from July - September 2015.



(1) The segment between I-370 and MD 97 (location of Toll Gantries I01/I02) opened on February 23, 2011 and was the only segment open in FY 2011. The segment operated toll free until the beginning of E-ZPass® toll operations on March 7, 2011 and the beginning of video toll operations on April 6, 2011.

(2) Toll Gantries I05/I06, I07/I08, I09/I10, and I13/I14 opened in November 22, 2011 (FY 2012). Toll operations began December 5, 2011.

(3) Toll Gantries I17/I18 opened November 10, 2014 (FY 2015).

Figure 2-1
Intercounty Connector Monthly Toll Transaction and Revenue Trends

2.2 2014 Average Weekday Traffic Volumes

The regional travel demand model used in the traffic and revenue forecasting process was based on annual average weekday traffic (AAWDT) volumes. Traffic counts were obtained from the Maryland State Highway Administration (MSHA) on major arterial roadways within the project corridor along nine screenlines, representing the major traffic flows east and west or north and south parallel to and including the ICC. These counts were necessary in order to understand the current ICC market share of traffic and to aid in the calibration of the regional travel demand model. CDM Smith also subcontracted with MCV Associates, Inc. (MCV) to obtain the additional counts needed at all ICC ramp locations and on major arterial roadways within the project corridor.

In addition, a balanced traffic profile of 2013 AAWDT volumes for each ICC ramp and mainline section was developed as part of the model calibration process in order to compare the model's traffic assignment output with actual traffic volumes. The complete mainline and ramp traffic profile was developed using count information provided at the existing toll gantries provided by Maryland Transportation Authority (MDTA) in conjunction with ICC ramp counts and traffic counts conducted on the non-tolled extension of the roadway (I-370) provided by MCV.

2.2.1 Project Screenlines

One assessment of the results of the tolled traffic assignments is whether the total volume crossing a grouping of parallel routes, called a screenline, compares well with actual traffic volumes. The variation between the traffic assignments from the travel demand model and the actual traffic counts may differ on individual roads; however, if the total assigned volumes crossing the screenlines are reasonably close to the counts, then this is an indication that overall traffic demand and travel patterns are being reasonably simulated by the model.

A total of nine screenlines were constructed along major travel corridors in the region in an effort to assess travel patterns on potential competing ICC routes, as well as routes that could feed traffic to the ICC or competing facilities. As shown in **Figure 2-2**, a screenline was placed near each of the ICC access points, as well as north and south of the ICC. FY 2014 AAWDT volumes, as shown in **Figure 2-3**, along these screenlines were developed from three primary sources. First, AAWDT volumes on the ICC were developed based on actual transaction data provided by MDTA. Second, available hourly counts were obtained through MSHA for all non-toll count locations. These counts from MSHA, which were conducted between 2011 and 2013, were factored to FY 2014 AAWDT levels. Additional data were collected by MCV where existing data were insufficient, as listed in **Table 2-3.** These additional counts were collected over a 72-hour period on internal weekdays (Tuesday through Thursday) in October 2014 by machine and radar/microwave-based equipment. The raw counts were adjusted to FY 2014 AAWDT levels using monthly factors developed from data provided by MSHA.

Based on the FY 2014 AAWDT volumes shown in **Figure 2-3**, a number of major corridors in the region can be identified. Besides the ICC, east-west movements are primarily served by I-495, with FY 2014 AAWDT volumes ranging from about 215,000 to 260,000 vehicles per weekday. Other arterial roadways such as MD 28, MD 198, MD 586 and Randolph Road carry east-west traffic as well, with 2014 AAWDT volumes ranging from roughly 25,000 to 50,000 vehicles per weekday. Major north-south roadways include I-95, I-270, US 1, US 29, MD 97, MD 185, MD 355 and New Hampshire Avenue, all of which have interchanges with the ICC. While I-95 and I-270 carried average weekday volumes ranging from roughly 200,000 to 260,000 vehicles in FY 2014, the north-south arterial roadways carried volumes ranging from roughly 35,000 to 70,000 vehicles.

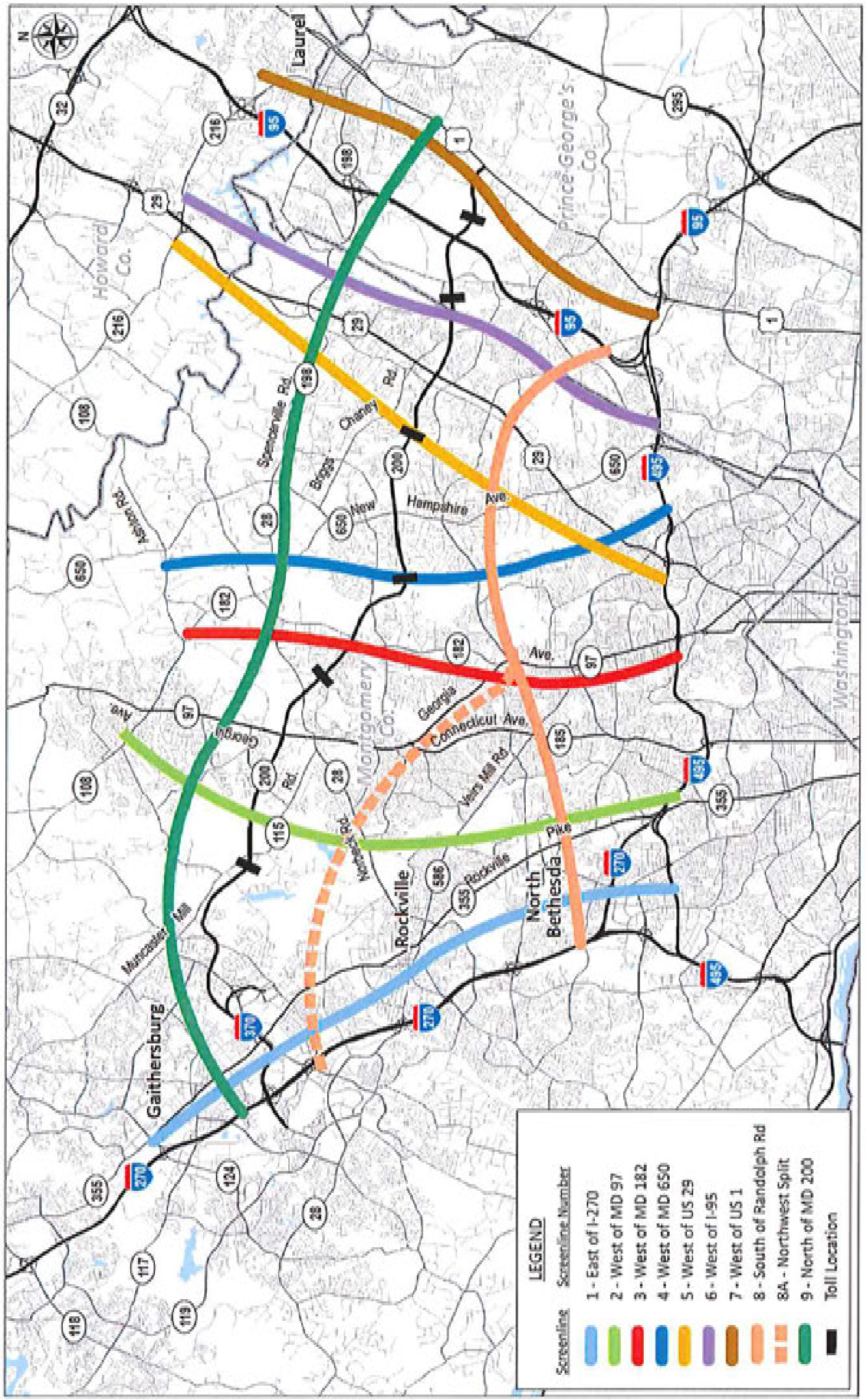


Figure 2-2
Intercounty Connector Screenline Locations

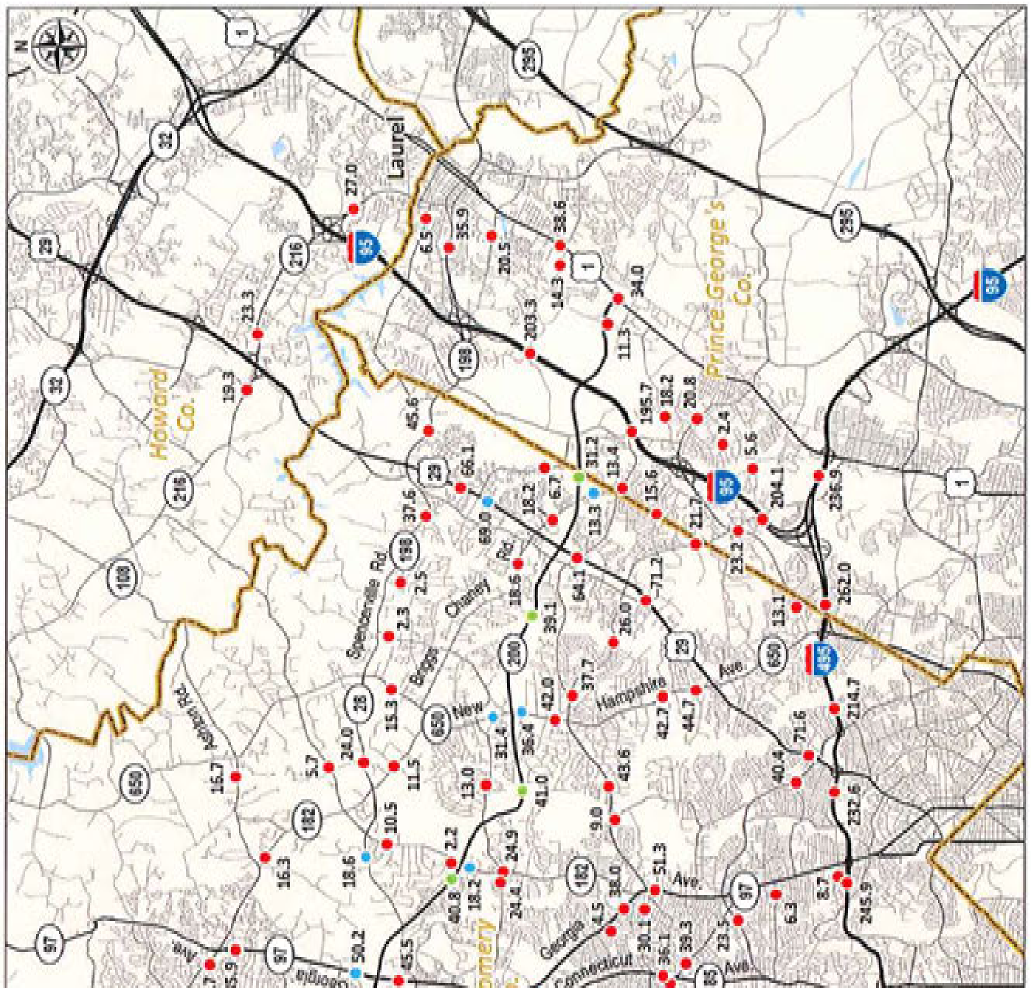


Figure 2-3
Regional FY 2014 Annual Average Weekday Traffic Volumes

Table 2-3
Additional Screenline Traffic Count Locations

Count ID	Route Number	Roadway	Location	Cross Street	Direction	Count Length
SL 1-10	MD 28	W Montgomery Ave.	W of	MD 355	Bi-Directional	72 Hour
SL 3-2	MD 28	Norbeck Rd.	W of	MD 182	Bi-Directional	72 Hour
SL 9-2	MD 355	S Frederick Ave.	N of	I-370	Bi-Directional	72 Hour
ICC S-3	MD 355	N Frederick Rd.	S of	Shady Grove Rd.	Bi-Directional	72 Hour
ICC S-6	MD 182	Layhill Rd.	S of	MD 200	Bi-Directional	72 Hour
ICC S-7	MD 650	New Hampshire Ave.	S of	MD 200	Bi-Directional	72 Hour
ICC S-9		Briggs Chaney Rd.	S of	MD 200	Bi-Directional	72 Hour
ICC N-3	MD 97	Georgia Ave.	N of	MD 200	Bi-Directional	72 Hour
ICC N-4	MD 650	New Hampshire Ave.	N of	MD 200	Bi-Directional	72 Hour
ICC N-5	US 29	Columbia Pike	S of	Greencastle Rd.	Bi-Directional	72 Hour

Given the higher tolls paid by 3+-axle vehicles on the ICC, CDM Smith also reviewed truck traffic volumes at the count locations, where available. Truck usage in the region, as illustrated in **Figure 2-4**, is largely limited to non-tolled highways such as I-95, I-495, I-270, with nearby arterials having the next greatest percentage of trucks. Truck volumes on I-495 and I-270 average around 8 percent of total traffic volumes, while I-95 maintains an average of closer to 10 percent trucks. Truck percentages also tend to be higher on arterial roads that have direct highway access, such as MD 355, MD 198, and Redland Extension, with a high of 16.0 percent trucks on MD 355 south of I-370. By comparison, the ICC has a maximum of 3.8 percent trucks on the far eastern end, which steadily decreases to 3.0 percent at the western end.

Table 2-4 provides traffic volumes for the ICC and the top five roadways along each screenline. Contee Road is included in Screenline 7 as this arterial is in roughly the same location as the ICC Extension to US 1 that opened in November 2014 (FY 2015). As shown in the table, the major carrier of east-west traffic in FY 2014 was I-495. The ICC carried roughly 40,000 vehicles per segment on an average weekday.

Based on the data collected, CDM Smith was able to assess the market share for the ICC by location. Market share is a significant measure of how successful a road is performing because it details the percent of drivers using a particular roadway segment compared to the total number of drivers on that particular screenline. Market share is also a function of how far the screenline is extended from the facility being analyzed. The further the screenline extends from the ICC, the more the overall market share of the ICC will decrease. Over time, new toll roads will tend to grab a higher share of the screenline traffic due to ramp-up, the fact that new development or redevelopment is likely to occur closer to a new facility, and due to other mature competing facilities getting more congested even with small increases in traffic levels. In FY 2014, the ICC market share ranged between 7.2 and 9.3 percent of east-west traffic in the study area. There was about a 5 percent differential in market share between the ICC and traffic captured by I-370, most likely due to the fact that I-370 is a toll-free facility. Market share was also lower on the east of the ICC, possible due to the lack of a connection to the local arterial network east of US 29 prior to the opening of the ICC Extension to US 1. The ICC definitely experienced an increase in market share in FY 2015 with an almost 20 percent increase in transactions and will continue to increase in FY 2016 due to the continued effects of facility ramp-up, the impacts of the toll decrease in July 2015 (FY 2016), additional development closer to the ICC and increases in congestion on competing facilities.

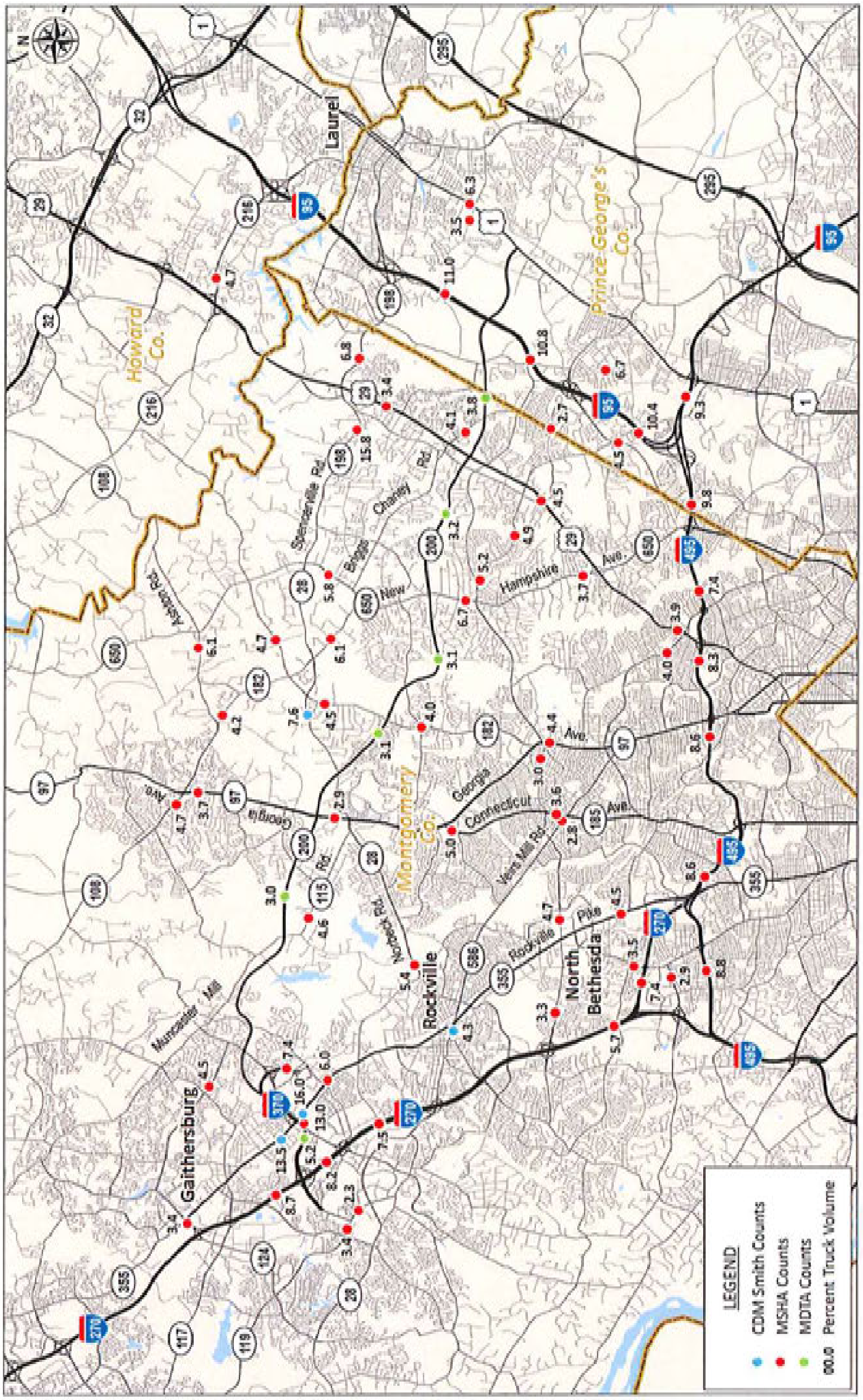


Figure 2-4
Truck Traffic as a Percent of Regional FY 2014 Annual Average Weekday Traffic Volumes

Table 2-4
FY 2014 Annual Average Weekday Traffic Volumes at Screenline Locations

Screenline	Street Name	Cross Street	FY 2014 AAWDT Volumes[1] Eastbound	Westbound	Total
Screenline 1 - East of I-270	I-370	I-270	49,271	50,174	99,445
	Shady Grove Rd	MD 355	27,390	16,711	44,101
	W Montgomery Ave	MD 355	11,190	12,423	23,613
	Montrose Rd	I-270	29,417	29,053	58,470
	I-270	MD 187B	64,531	65,260	129,791
	I-495	MD 187	54,124	54,667	108,791
	Other Roadways		139,725	126,328	266,053
	Total Screenline Traffic Volumes		**375,648**	**354,616**	**730,264**
	Percent I-370 Market Share for Screenline		13.1	14.1	13.6
Screenline 2 - West of MD 97	Olney Laytonsville Rd	MD 97	15,676	15,055	30,731
	ICC	**I-370 & MD 97**	**20,704**	**20,413**	**41,116**
	Norbeck Rd	E. Gude Dr	23,343	24,318	47,661
	Veirs Mill Rd	Twinbrook Pkwy	23,417	22,323	45,740
	Randolph Rd	MD 355	12,769	12,202	24,971
	I-495	MD 355	113,361	121,700	235,061
	Other Roadways		17,198	17,216	34,414
	Total Screenline Traffic Volumes		**226,468**	**233,226**	**459,694**
	Percent ICC Market Share for Screenline		9.1	8.8	8.9
Screenline 3 - West of MD 182	**ICC**	**MD 97 & MD 182**	**20,407**	**20,419**	**40,826**
	Georgia Ave	MD 185	17,843	20,118	37,961
	Randolph Rd	MD 97	15,248	14,863	30,111
	Veirs Mill Rd	MD 185	19,998	19,322	39,320
	University Blvd W	MD 586	11,589	11,932	23,521
	I-495	MD 97	120,964	124,947	245,911
	Other Roadways		38,879	37,509	76,388
	Total Screenline Traffic Volumes		**244,927**	**249,110**	**494,038**
	Percent ICC Market Share for Screenline		8.3	8.2	8.3
Screenline 4 - West of MD 650	Olney Sandy Spring Rd	MD 650 (Ashton)	8,396	8,285	16,681
	Norbeck Rd	MD 650	11,545	12,417	23,962
	ICC	**MD 182 & MD 650**	**20,552**	**20,488**	**41,040**
	Randolph Rd	MD 650	21,029	22,532	43,561
	Colesville Rd	MD 193	36,684	34,916	71,600
	I-495	MD 650	112,205	102,521	214,726
	Other Roadways		15,263	15,263	30,526
	Total Screenline Traffic Volumes		**225,674**	**216,423**	**442,097**
	Percent ICC Market Share for Screenline		9.1	9.5	9.3
Screenline 5 - West of US 29	Old Columbia Pike	US 29A	18,949	18,683	37,632
	ICC	**MD 650 & US 29**	**19,592**	**19,459**	**39,051**
	E Randolph Rd	MD 650	18,356	19,314	37,670
	New Hampshire Ave	US 29	21,920	22,771	44,691
	University Blvd W	US 29	20,873	19,558	40,431
	I-495	MD 97	115,266	117,355	232,621
	Other Roadways		18,942	18,942	37,883
	Total Screenline Traffic Volumes		**233,897**	**236,081**	**469,979**
	Percent ICC Market Share for Screenline		8.4	8.2	8.3
Screenline 6 - West of I-95	**Scaggsville Rd**	**Crest Rd**	**11,497**	**11,846**	**23,343**
	Sandy Spring Rd	I-95	22,417	23,153	45,570
	ICC	US 29 & I-95	15,470	15,736	31,205
	Calverton Blvd	Beltsville Dr	7,333	8,249	15,582
	Cherry Hill Rd	MD 212	10,532	11,179	21,711
	I-495	MD 212	134,130	127,844	261,974
	Other Roadways		15,254	17,889	33,143
	Total Screenline Traffic Volumes		**216,633**	**215,895**	**432,528**
	Percent ICC Market Share for Screenline		7.1	7.3	7.2
Screenline 7 - West of US 1	Scaggsville Rd	I-95	14,063	12,910	26,973
	Sandy Spring Rd	Van Dusen Rd	18,792	17,100	35,892
	Contee Rd	**US 1**	**7,278**	**7,044**	**14,322**
	Ammendale Rd	Powder Mill Rd	9,390	8,782	18,172
	Powder Mill Rd	Old Gunpowder Rd	11,235	9,517	20,752
	I-495	US 1	116,439	120,452	236,891
	Other Roadways		23,052	23,163	46,215
	Total Screenline Traffic Volumes		**200,249**	**198,968**	**399,217**
	Percent Contee Rd. Market Share for Screenline		3.6	3.5	3.6
Screenline 8 - South of Randolph Rd	**I-270**	**Tuckerman La**	**132,623**	**130,658**	**263,281**
	Old Georgetown Rd	I-270	29,648	30,844	60,492
	MD 355	MD 547	26,958	27,573	54,531
	MD 97	Randolph Rd	24,934	26,367	51,301
	US 29	Industrial Pkwy	34,962	36,278	71,240
	I-95	MD 212	105,085	99,006	204,091
	Other Roadways		77,425	77,941	155,366
	Total Screenline Traffic Volumes		**431,635**	**428,667**	**860,302**
Screenline 8A - Northwest Split	Randolph Rd	MD 97	15,248	14,863	30,111
	Weller Rd	MD 97 & Flack St	1,798	2,663	4,461
	Connecticut Ave	**MD 97**	**19,503**	**19,717**	**39,220**
	Norbeck Rd	E. Gude Dr	23,343	24,318	47,661
	Southlawn La	E Gude Dr	5,718	5,193	10,911
	Frederick Rd	Fields Rd	25,336	23,515	48,851
	I-270	MD 28	124,807	115,404	240,211
	Total Screenline Traffic Volumes		**215,755**	**205,671**	**421,426**
Screenline 9 - North of ICC	I-270	I-370	109,309	109,552	218,861
	MD 355	**I-370**	**21,020**	**19,922**	**40,942**
	MD 97	MD 108	17,239	18,652	35,891
	US 29	MD 198	33,489	32,621	66,110
	I-95	Van Dusen Rd	102,687	100,574	203,261
	US 1	Contee Rd	17,601	21,049	38,650
	Other Roadways		60,753	60,616	121,369
	Total Screenline Traffic Volumes		**362,099**	**362,986**	**725,084**

(1) AAWDT - Average Annual Weekday Traffic

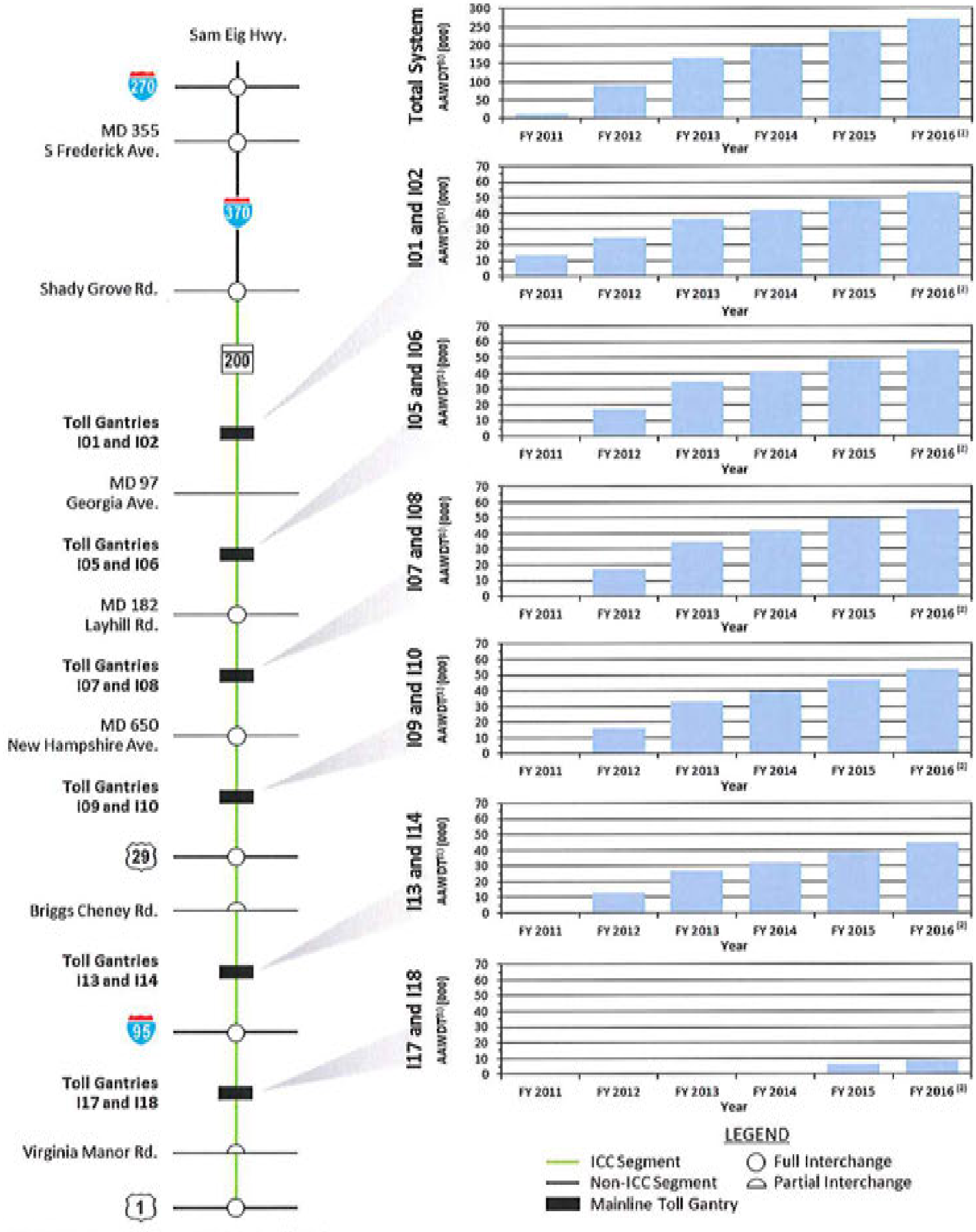
2.2.2 Balanced ICC Traffic Profile

Historical AAWDT by mainline toll location is presented in **Figure 2-5**. Toll Gantries I01 and I02 opened in FY 2011, while the remaining opened in FY 2012, with the exception of I17 and I18, which opened in November 2014 (FY 2015) as part of the ICC Extension to US 1. Transactions on every mainline segment have continually increased every year the facility has been in operation. All toll gantries have had relatively similar volumes through the years, with approximately 40,000 average daily transactions per gantry in FY 2014, with the exception of the gantries between east of US-29 / Briggs Chaney Road, which had lower traffic volumes. The segment between US 29 and I-95 had approximately 30,000 average daily transactions in FY 2014. Volumes have increased to over 50,000 average daily transactions per gantry in FY 2014 west of US 29 and to 40,000 and 10,000 average daily transactions on the remaining two segments, respectively. The figure clearly illustrates the significant growth that has been experienced at each gantry location on the system, with continued year-over-year growth between FY 2011 and FY 2016.

A complete profile of FY 2014 AAWDT volumes on the ICC was prepared for this study by obtaining actual transaction data for the entire 2014 fiscal year for all mainline toll gantries open during this time from MDTA. CDM Smith also received entry and exit point data for all trips occurring on the ICC during FY 2014. From this data, CDM Smith was able to determine specific trip movements and AAWDT volumes at all toll gantries. The complete balanced profile for the ICC, between I-370 and I-95, and the adjacent I-370, spanning from I-270 to the ICC, was developed in conjunction with auxiliary ramp counts collected at all ramps on the corridor by MCV Associates, Inc. These counts were conducted in 15-minute intervals over a span of 7 days in September and October 2014. These counts were then limited to internal weekdays (Tuesday – Thursday), while eliminating any holidays that would alter normal traffic patterns, in order to determine AAWDT. While mainlines on the ICC were obtained directly from MDTA, mainlines on I-370 were estimated, balancing mainline and ramp volumes westward from the ICC.

The FY 2014 AAWDT profile for the ICC and the adjacent I-370, which was included because it feeds into the ICC, is shown in **Figure 2-6**. The peak AAWDT volume on I-370 is an estimated 99,500 vehicles just east of I-270. East of the interchange for Shady Grove Road, the western terminus of the ICC, traffic volumes reduce significantly moving eastward onto the ICC. The last pair of ramps prior to the ICC carry some of the highest volumes in the combined ICC / I-370 corridor, with an average of 13,600 and 18,500 vehicles per day, respectively. Traffic averages about 41,000 entering the tolled ICC facility, and remains fairly constant until the US 29 interchange, where traffic is around 30,000 for the remaining mainlines. The heaviest interchange volumes on the roadway include the connection to other limited-access highways, including I-95, US 29, I-370, and Shady Grove Road. Volumes to and from I-95 along the ICC are significant, at over 30,000 vehicles on an average weekday in 2014. Count data for FY 2015 show this connection to be the most important for the ICC as it continues to drive much of the growth on the ICC. Future development around this interchange will continue to push volumes on these ramps higher.

Figures 2-7 and 2-8 show the AAWDT volumes split into AM Peak, PM Peak, Off-Peak, and Overnight periods. The AM Peak Period is defined as weekdays 6:00 – 9:00 AM and the PM Peak Period is defined as weekdays 4:00 – 7:00 PM. The Off-Peak Period includes weekdays 5:00 – 6:00 AM, 9:00 AM – 4:00 PM, and 7:00 – 11:00 PM. The Overnight Period is 11:00 PM – 5:00 AM.



(1) AAWDT - Annual Average Weekday Traffic Volume.
(2) Based on average of FY 2016 weekday data through Sept. 2015.
NOTE: Numbers based on transaction data.

Figure 2-5
Historical Average Annual Weekday Traffic Volumes by Mainline Toll Location

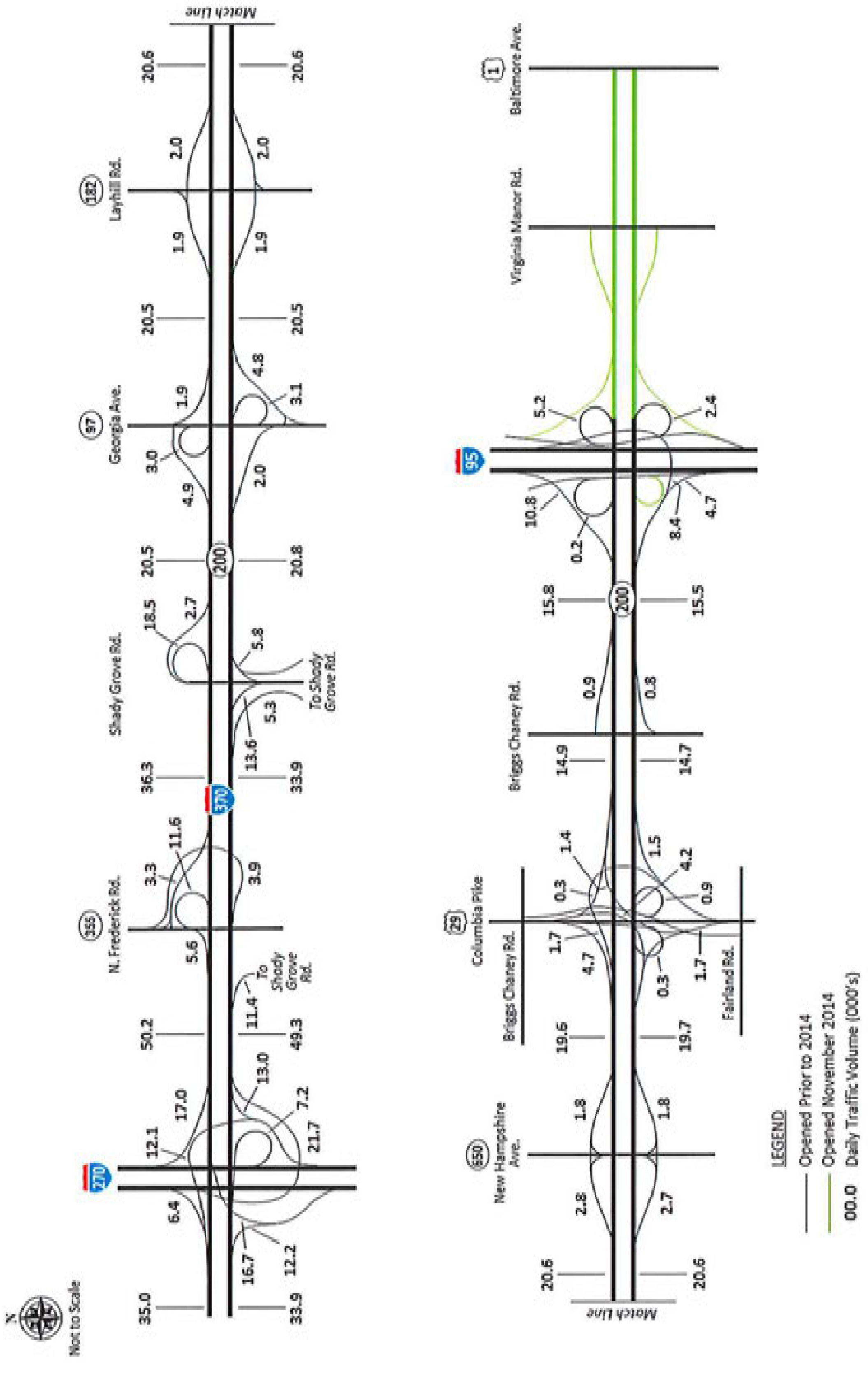


Figure 2-6
Balanced Profile of FY 2014 Average Annual Weekday Traffic Volumes on the Intercounty Connector

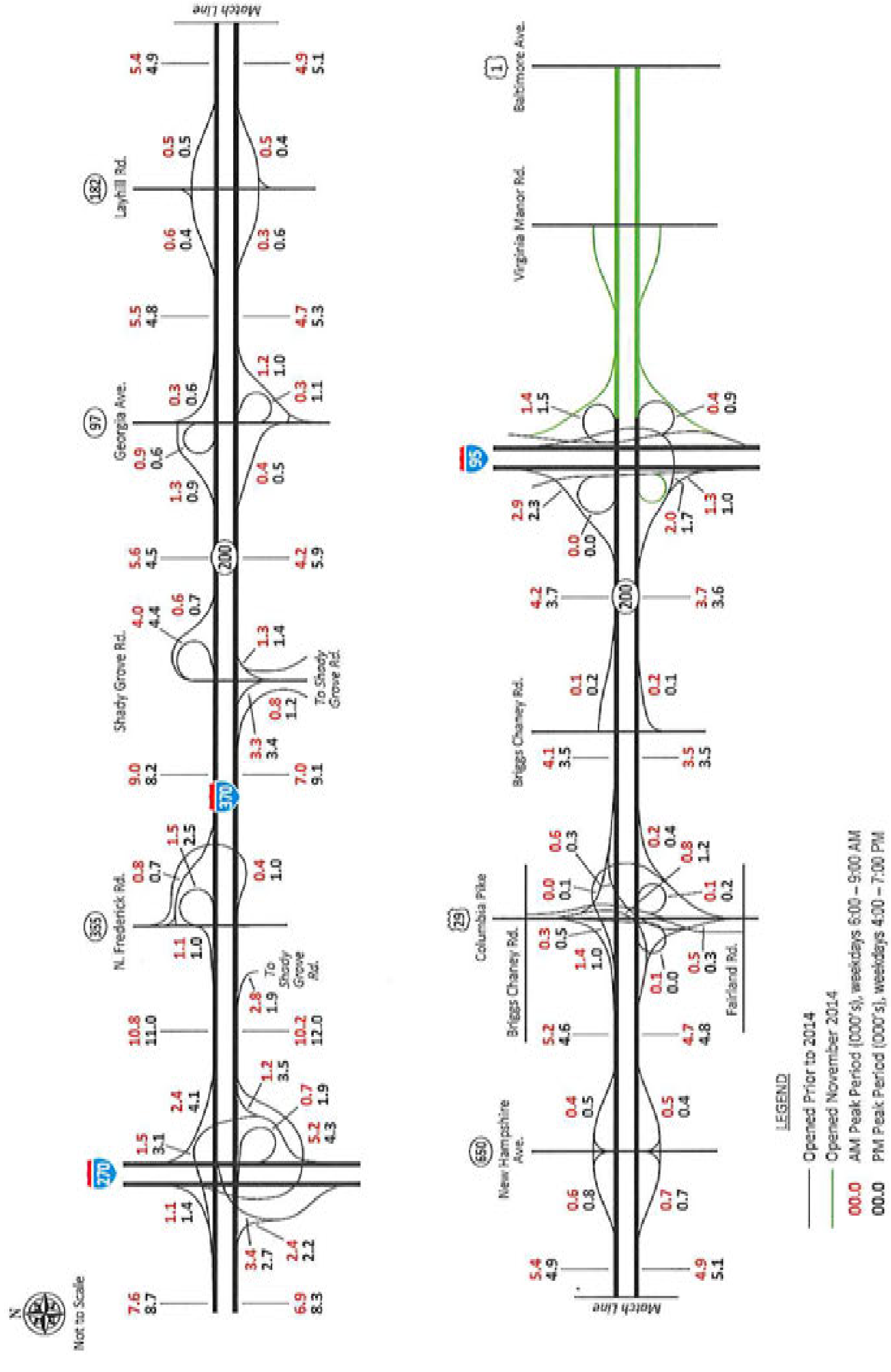


Figure 2-7
Balanced Profile of FY 2014 Average Annual Weekday Traffic Volumes
During the AM and PM Peak Periods on the Intercounty Connector

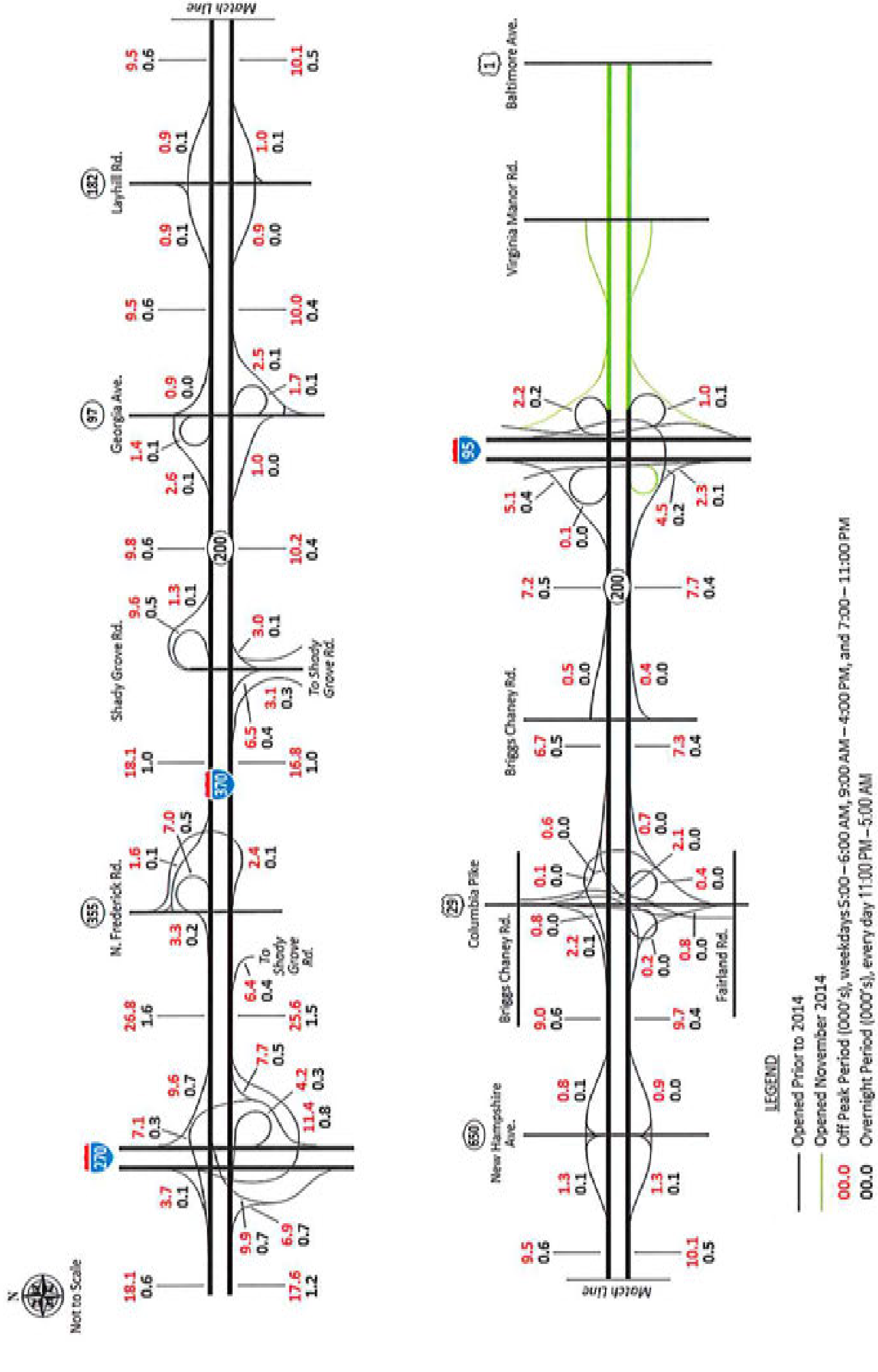


Figure 2-8
Balanced Profile of FY 2014 Average Annual Weekday Traffic Volumes
During the Off-Peak and Overnight Periods on the Intercounty Connector

The ICC is an east-west suburban connector between the highly traveled commuting corridors of I-95 and I-270, connecting Washington, D.C., to Frederick, MD and Baltimore, MD. Due to this orientation, there is no distinct peak direction of traffic. **Figure 2-7** (shown previously) shows traffic to be slightly higher during the westbound AM Peak Period and the eastbound PM Peak Period. Ramp volumes are fairly consistent during AM and PM Peak Periods throughout the entire corridor.

Figure 2-8 (shown previously) shows that the Off-Peak and Overnight travel volumes on the corridor are significantly lower than Peak Period volumes on an hourly basis, as the peak periods are 3-hour intervals, while the Off-Peak Period totals 12 hours. Off-Peak mainline traffic more closely mirrors the pattern found in the PM Peak Period as westbound volumes tend to be higher on the tolled segments. Overnight traffic volumes on the ICC (from 11:00 PM to 5:00 AM) are very low, as would be expected. The highest mainline carries an average of 1,100 vehicles during the Overnight Period.

2.2.3 Interchange-to-Interchange Matrices

From the trip-level data provided by the MDTA, CDM Smith was able to develop a matrix of interchange-to-interchange movements. **Table 2-5** presents the interchange-to-interchange trip matrix for the ICC for the average annual weekday in FY 2014. The most common movements throughout the entire ICC system tend to be longer movements that span multiple toll gantries. The top movement both eastbound and westbound, with 25.6 percent of total trips, is a trip traveling the entire system, between I-370 or Shady Grove Road and I-95, with an average of 16,258 trips every day. The third and fourth most frequent trips on the ICC are between I-370 or Shady Grove Road and US 29 and Briggs Chaney Road and between MD 97 / Georgia Avenue and I-95. These trips are the second longest trips that can be taken on the ICC. Other popular movements on the ICC span one interchange. The second most common movement is between I-370 or Shady Grove Road and MD 97 / Georgia Avenue, which is the first movement on the western edge of the facility. This movement also involves the largest distance (5.65 miles) between interchanges in the entire system. Another popular movement is between US 29 and Briggs Chaney Road and I-95, which provides local road access from I-95 and provides highway access from Briggs Chaney Road. **Figure 2-9** provides a visual representation of the total system trip matrix found in **Table 2-5**, while **Table 2-6** lists the interchange-to-interchange movements by AAWDT volume in order from highest to lowest.

The average access and egress volumes for each interchange on the ICC roadway are also provided in **Table 2-5** in the column and row totals. The trip-level data indicates that I-370 or Shady Grove Road is the most used access and egress point on the ICC with an average daily use of more than 40,000 trips. Movements involving I-95 are the second most frequent trips on the ICC, with 31,206 daily trips.

2.3 Monthly Traffic Variations

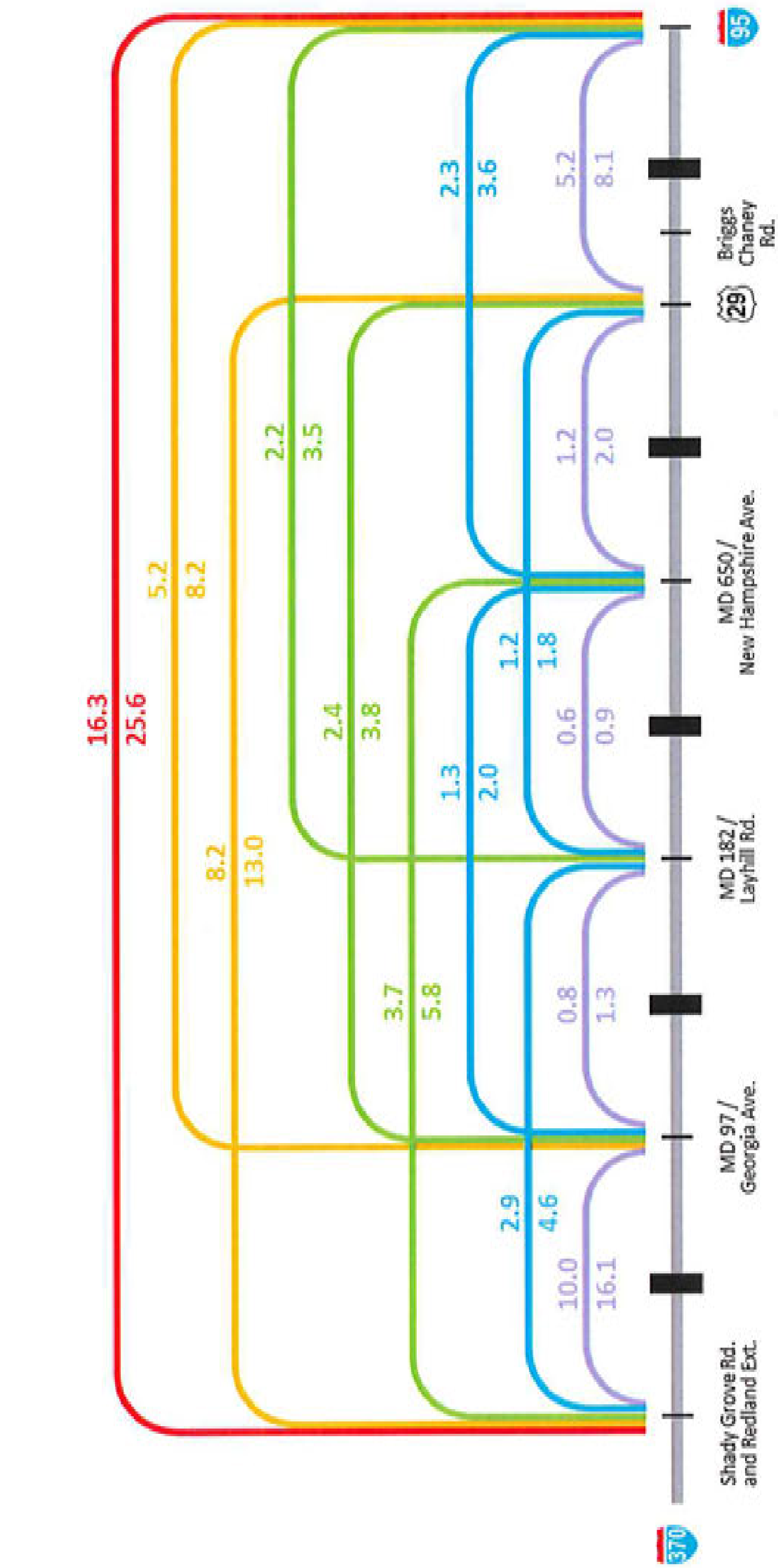
Figure 2-10 provides a summary of monthly traffic variations on the ICC for FY 2014 by both mainline toll gantry and averaged over all gantry locations. The dashed horizontal line reflects the average month, or an index value of 1.0. Across the entire roadway, September through November and March are about average, while April through June are above average. July, August, and December through February are below the annual average. At all tolling locations, January had the lowest monthly volume, with an average of 10 percent below the average month, while May and June both averaged 14 percent about the average month on a system-wide basis. **Table 2-7** shows the traffic volumes that support **Figure 2-10**. The monthly factors stay fairly constant at each of the gantry locations.

Table 2-5
FY 2014 Average Annual Weekday Interchange-to-Interchange Movements

	Exit					
EASTBOUND	MD 97 / Georgia Ave.	MD 182 / Layhill Rd.	MD 650 / New Hampshire Ave.	US 29	I-95	Total
Entrance: I-370; Shady Grove Rd.	5,143 *16.1*	1,477 *4.6*	1,829 *5.7*	4,218 *13.2*	8,036 *25.2*	**20,704** ***64.9***
MD 97 / Georgia Ave.		386 *1.2*	623 *2.0*	1,232 *3.9*	2,605 *8.2*	**4,847** ***15.2***
MD 182 / Layhill Rd.			265 *0.8*	603 *1.9*	1,140 *3.6*	**2,009** ***6.3***
MD 650 / New Hampshire Ave.				639 *2.0*	1,118 *3.5*	**1,756** ***5.5***
US 29 and Briggs Cheney Rd.					2,570 *8.1*	**2,570** ***8.1***
Total	**5,143** ***16.1***	**1,863** ***5.8***	**2,717** ***8.5***	**6,692** ***21.0***	**15,470** ***48.5***	**31,885** ***100.0***

	Exit					
WESTBOUND	US 29 and Briggs Cheney Rd.	MD 650 / New Hampshire Ave.	MD 182 / Layhill Rd.	MD 97 / Georgia Ave.	I-370; Shady Grove Rd.	Total
Entrance: I-95	2,592 *8.2*	1,188 *3.8*	1,102 *3.5*	2,632 *8.3*	8,221 *26.0*	**15,736** ***49.8***
US 29		593 *1.9*	558 *1.8*	1,166 *3.7*	4,000 *12.6*	**6,316** ***20.0***
MD 650 / New Hampshire Ave.			296 *0.9*	653 *2.1*	1,861 *5.9*	**2,810** ***8.9***
MD 182 / Layhill Rd.				430 *1.4*	1,457 *4.6*	**1,887** ***6.0***
MD 97 / Georgia Ave.					4,874 *15.4*	**4,874** ***15.4***
Total	**2,592** ***8.2***	**1,781** ***5.6***	**1,956** ***6.2***	**4,880** ***15.4***	**20,413** ***64.6***	**31,622** ***100.0***

Total System	MD 97 / Georgia Ave.	MD 182 / Layhill Rd.	MD 650 / New Hampshire Ave.	US 29	I-95	Total
I-370; Shady Grove Rd.	10,017 *15.8*	2,934 *4.6*	3,690 *5.8*	8,217 *13.0*	16,258 *25.6*	**41,116** ***64.7***
MD 97 / Georgia Ave.		816 *1.3*	1,276 *2.0*	2,398 *3.8*	5,237 *8.2*	**9,727** ***15.3***
MD 182 / Layhill Rd.			561 *0.9*	1,161 *1.8*	2,242 *3.5*	**3,964** ***6.2***
MD 650 / New Hampshire Ave.				1,232 *2.0*	2,306 *3.6*	**3,537** ***5.6***
US 29 and Briggs Cheney Rd.					5,163 *8.1*	**5,163** ***8.1***
Total	**10,017** ***15.8***	**3,750** ***5.9***	**5,527** ***8.7***	**13,008** ***20.5***	**31,205** ***49.1***	**63,507** ***100.0***



LEGEND

0.0 — Average Annual Weekday Traffic (000's) (combined directions)

0 — Percent of Total Trips

Note: Total Average Annual Weekday ICC Trips - 63,507

Figure 2-9

FY 2014 Average Annual Weekday Interchange-to-Interchange Movements

Table 2-6
FY 2014 Average Annual Weekday Interchange-to-Interchange Movements
Listed by Volume and Percent of Total

Volume	Percent of Trips	Interchange Movement	
16,258	25.6	I-370; Shady Grove Rd.	I-95
10,017	15.8	I-370; Shady Grove Rd.	MD 97 / Georgia Ave.
8,217	12.9	I-370; Shady Grove Rd.	US 29
5,237	8.2	MD 97 / Georgia Ave.	I-95
5,163	8.1	US 29 and Briggs Cheney Rd.	I-95
3,690	5.8	I-370; Shady Grove Rd.	MD 650 / New Hampshire Ave.
2,934	4.6	I-370; Shady Grove Rd.	MD 182 / Layhill Rd.
2,398	3.8	MD 97 / Georgia Ave.	US 29
2,306	3.6	MD 650 / New Hampshire Ave.	I-95
2,242	3.5	MD 182 / Layhill Rd.	I-95
1,276	2.0	MD 97 / Georgia Ave.	MD 650 / New Hampshire Ave.
1,232	1.9	MD 650 / New Hampshire Ave.	US 29
1,161	1.8	MD 182 / Layhill Rd.	US 29
816	1.3	MD 97 / Georgia Ave.	MD 182 / Layhill Rd.
561	0.9	MD 182 / Layhill Rd.	MD 650 / New Hampshire Ave.
63,507	**100.0**	**Total**	

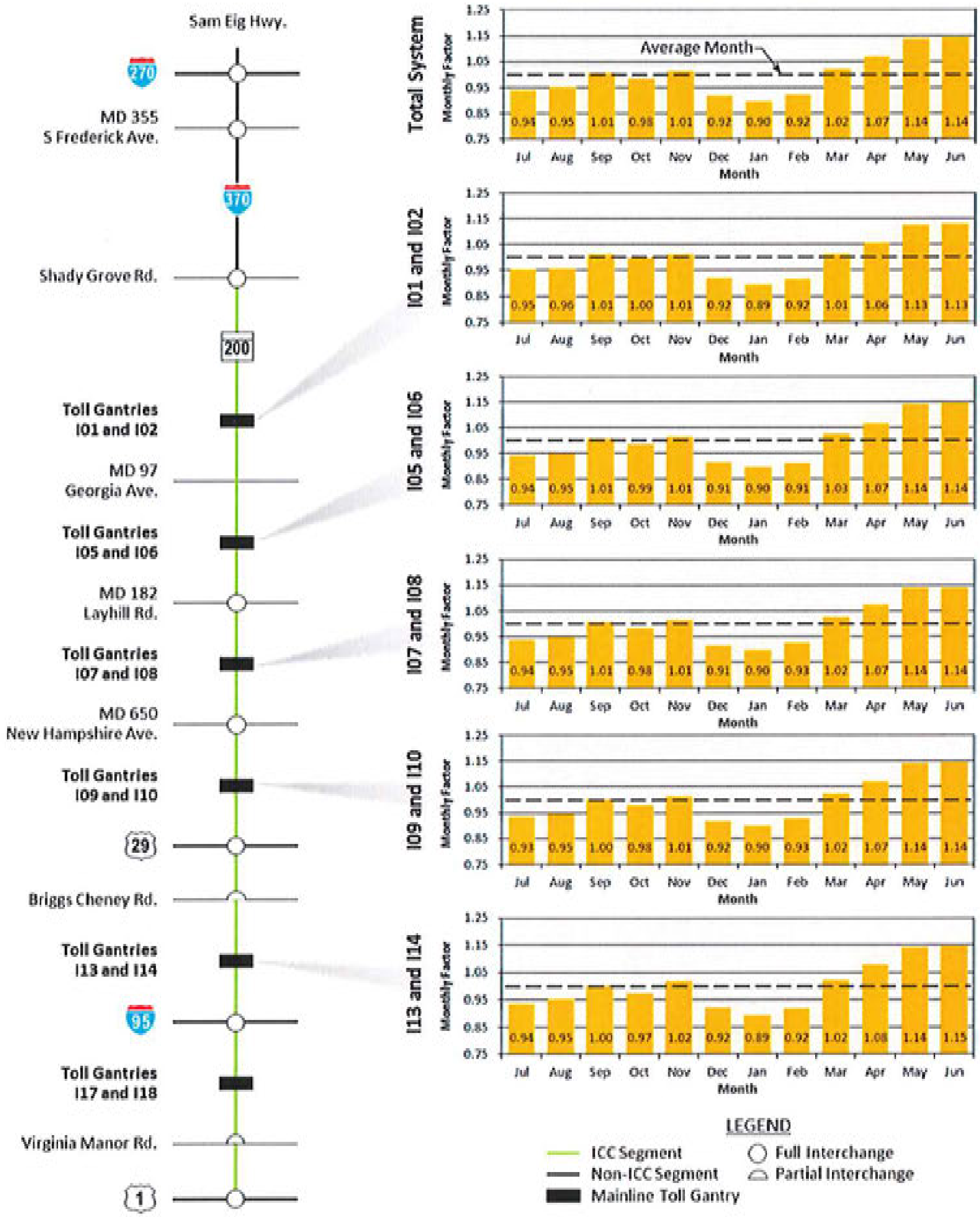


Figure 2-10
FY 2014 Average Monthly Traffic Variations by Mainline Toll Location

Table 2-7
FY 2014 Monthly Variation by Mainline Segment

Month	I01 / I02 Between I-370 & MD 97		I05 / I06 Between MD 97 & MD 182		I07 / I08 Between MD 182 & MD 650		I09 - I10 Between MD 650 & US 29		I13 - I14 Between US 29 & I-95		Average Volume	
	AAWDT[1]	Factor	AAWDT[1]	Factor	AAWDT[1]	Factor	AAWDT[1]	Factor	AAWDT[1]	Factor	AAWDT[1]	Factor
July	40,201	0.95	39,254	0.94	39,122	0.94	37,270	0.93	30,133	0.94	37,196	0.94
August	40,319	0.96	39,578	0.95	39,681	0.95	37,801	0.95	30,702	0.95	37,616	0.95
September	42,699	1.01	41,994	1.01	42,055	1.01	39,910	1.00	32,189	1.00	39,769	1.01
October	41,975	1.00	41,138	0.99	41,102	0.98	39,026	0.98	31,321	0.97	38,913	0.98
November	42,700	1.01	42,298	1.01	42,372	1.01	40,454	1.01	32,737	1.02	40,112	1.01
December	38,819	0.92	38,095	0.91	38,221	0.91	36,576	0.92	29,599	0.92	36,262	0.92
January	37,598	0.89	37,400	0.90	37,492	0.90	35,806	0.90	28,707	0.89	35,401	0.90
February	38,584	0.92	37,985	0.91	38,747	0.93	37,020	0.93	29,568	0.92	36,381	0.92
March	42,668	1.01	42,725	1.03	42,856	1.02	40,864	1.02	32,930	1.02	40,408	1.02
April	44,574	1.06	44,499	1.07	44,917	1.07	42,743	1.07	34,670	1.08	42,281	1.07
May	47,503	1.13	47,502	1.14	47,713	1.14	45,470	1.14	36,715	1.14	44,981	1.14
June	47,639	1.13	47,650	1.14	47,743	1.14	45,625	1.14	36,869	1.15	45,105	1.14
Annual Average	**42,107**	**1.00**	**41,677**	**1.00**	**41,835**	**1.00**	**39,880**	**1.00**	**32,178**	**1.00**	**39,535**	**1.00**

Source: MDTA

[1] Average Annual Weekday Traffic

This would suggest that any seasonal factors affecting the ICC do so at a roughly equal level across the entire corridor, rather than affecting specific segments of the roadway. In addition, 25 percent of the traffic is through traffic, which is a significant weight in how the individual gantries will perform.

2.4 Daily Traffic Variations

Figure 2-11 provides an index of daily traffic variations for an average week in FY 2014 both by mainline toll gantry and system-wide total. The dashed horizontal line and an index of 1.0 represent the average day of the week. Traffic is lowest on the weekend, as is true with most urban toll facilities. This can likely be attributed to far fewer work-based trips being conducted on the weekend, which typically contains a lot more discretionary trips. Traffic is at its lowest on Sunday, at 65 percent of average weekly traffic levels, and increases daily to 16 percent over the weekly average by Friday, before dropping back down to 78 percent of the weekly average on Saturday. This pattern is typical of urban facilities that have higher traffic levels Monday through Friday, and lower traffic volumes Saturday and Sunday. Friday volumes tend to be higher as they include both weekday commuters and work trips and the beginning of weekend recreational and shopping trips. This pattern is consistent at all gantries throughout the system.

2.5 Hourly Traffic Variations

Table 2-8 provides a summary of the typical hourly traffic variations at the five mainline toll locations open during FY 2014 for the average weekday, as well as the system-wide average. The same data can be found for weekends in **Table 2-9**. Peak hours are consistent throughout the facility, with an AM Peak Hour of 8:00 – 9:00 AM holding 10.9 percent of the facility's daily traffic, and a PM Peak Hour of 5:00 – 6:00 PM holding 9.2 percent of daily traffic. The western end of the system has peak hour volumes of around 4,500 vehicles in the AM and 3,850 in the PM, while these volumes decrease to a low of 3,277 for AM and 2,729 for PM between US 29 and I-95. **Figure 2-12**, which provides a graphical representation of the typical hourly traffic variations, illustrates the higher westbound AM volumes at all gantries on the system. Around midday, these volumes switch to a majority of eastbound traffic, a trend that continues into the PM Peak Period.

Weekend travel patterns differ from the average weekday in that there are typically no peak periods, as travel is spread throughout the day. Rather than having both an AM and PM Peak Period, weekend traffic tends to build up to a single daily peak, and then decrease for the remainder of the day. The weekend daily peaks tend to occur between noon and 5:00 PM throughout the facility, but differ based on travel direction and toll location. However, at all points, the traffic at each gantry's peak weekend hour is roughly 7.5 percent of the total day's traffic at that location. The total number of transactions on an average weekend day on the ICC is 37.3 percent lower as compared to an average weekday, at 121,173.

2.6 Transactions by Vehicle Class

Table 2-10 presents a summary of transactions by vehicle class and payment type for the entire ICC facility since its opening in FY 2011. As of September 2014, passenger cars comprised 97.1 percent of all transactions on the ICC. In its opening year, 96.5 percent of the ICC's transactions were passenger cars. This percent has increased to 97.1 percent in FY 2014. Since the opening of the facility in FY 2011, the total number of transactions for both passenger cars and commercial vehicles has grown significantly every year as ramp-up proceeds.

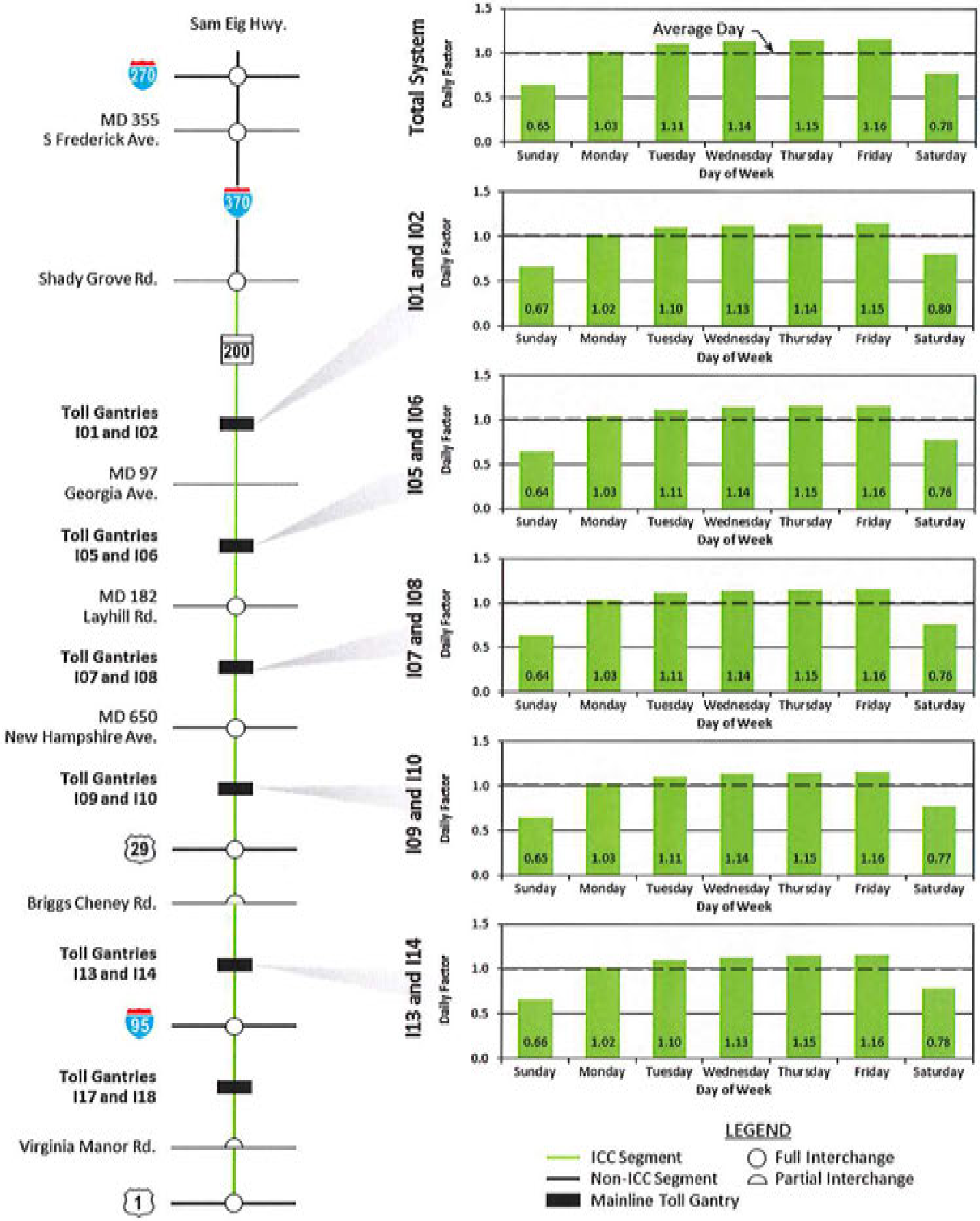


Figure 2-11
FY 2014 Average Daily Traffic Variations by Mainline Toll Location

Table 2-8
FY 2014 Average Annual Weekday Hourly Traffic Variations

	Between I-370 & MD 97						Between MD 97 & MD 182						Between MD 182 & MD 650					
	101 - Eastbound		102 - Westbound		Total		105 - Eastbound		106 - Westbound		Total		107 - Eastbound		108 - Westbound		Total	
Hour	Volume	Percent of Total Day	Volume	Percent of Total Day	Volume	Percent of Total Day	Volume	Percent of Total Day	Volume	Percent of Total Day	Volume	Percent of Total Day	Volume	Percent of Total Day	Volume	Percent of Total Day	Volume	Percent of Total Day
0	83	0.40	118	0.58	201	0.49	77	0.38	129	0.63	206	0.50	76	0.37	135	0.66	211	0.51
1	44	0.21	66	0.32	110	0.27	42	0.21	74	0.36	115	0.28	42	0	75	0.36	116	0.28
2	30	0.14	42	0.20	71	0.17	30	0.15	48	0.24	79	0.19	32	0.16	50	0.24	82	0.20
3	37	0.18	44	0.22	82	0.20	41	0.20	48	0.24	99	0.22	46	0.23	49	0.24	95	0.23
4	89	0.43	86	0.42	175	0.43	105	0.52	81	0.40	187	0.46	115	0.56	82	0.40	197	0.48
5	262	1.26	315	1.54	577	1.40	312	1.53	287	1.40	599	1.47	332	1.61	285	1.39	617	1.50
6	742	3.58	935	4.58	1,677	4.08	841	4.12	941	4.61	1,782	4.37	897	4.37	915	4.61	1,842	4.49
7	1,669	8.06	2,036	9.98	3,705	9.01	1,810	8.87	2,049	10.03	3,859	9.45	1,890	9.20	2,063	10.07	3,953	9.63
8	**1,821**	**8.80**	**2,640**	**12.93**	**4,461**	**10.85**	**2,019**	**9.89**	**2,495**	**12.22**	**4,514**	**11.06**	**2,119**	**10.31**	**2,440**	**11.91**	**4,559**	**11.11**
9	1,281	6.19	1,772	8.68	3,053	7.42	1,398	6.85	1,691	8.28	3,089	7.57	1,454	7.08	1,658	8.09	3,112	7.58
10	896	4.33	1,011	4.95	1,907	4.64	953	4.68	938	4.59	1,893	4.64	985	4.79	914	4.46	1,899	4.63
11	837	4.04	818	4.01	1,655	4.02	850	4.17	760	3.72	1,610	3.94	868	4.22	746	3.64	1,615	3.93
12	875	4.22	809	3.96	1,684	4.10	870	4.26	762	3.73	1,632	4.00	878	4.27	752	3.67	1,630	3.97
13	906	4.38	812	3.98	1,719	4.18	883	4.33	773	3.78	1,656	4.06	888	4.32	765	3.73	1,653	4.03
14	1,195	5.77	916	4.49	2,111	5.13	1,131	5.54	906	4.44	2,037	4.99	1,129	5.49	886	4.32	2,015	4.91
15	1,593	7.70	1,138	5.57	2,731	6.64	1,513	7.42	1,164	5.70	2,677	6.56	1,495	7.27	1,167	5.69	2,661	6.48
16	1,928	9.31	1,416	6.94	3,344	8.13	1,780	8.72	1,516	7.42	3,296	8.07	1,740	8.47	1,539	7.51	3,279	7.99
17	**2,247**	**10.85**	**1,695**	**8.30**	**3,942**	**9.59**	**1,995**	**9.78**	**1,854**	**9.08**	**3,849**	**9.43**	**1,908**	**9.29**	**1,900**	**9.27**	**3,808**	**9.28**
18	1,660	8.02	1,366	6.69	3,026	7.36	1,514	7.42	1,479	7.25	2,993	7.33	1,474	7.17	1,519	7.41	2,993	7.29
19	972	4.70	815	3.99	1,787	4.35	862	4.23	842	4.12	1,704	4.17	844	4.11	866	4.23	1,710	4.17
20	606	2.93	567	2.78	1,173	2.85	540	2.65	558	2.73	1,098	2.69	523	2.55	573	2.80	1,096	2.67
21	467	2.25	465	2.28	931	2.27	414	2.03	466	2.28	880	2.16	399	1.94	487	2.38	886	2.16
22	299	1.44	325	1.59	624	1.52	272	1.33	339	1.66	611	1.50	267	1.30	359	1.75	627	1.53
23	165	0.80	206	1.01	371	0.90	150	0.74	221	1.08	371	0.91	149	0.73	234	1.14	383	0.93
Total Day	**20,704**	**100.0**	**20,413**	**100.0**	**41,116**	**100.0**	**20,407**	**100.0**	**20,419**	**100.0**	**40,826**	**100.0**	**20,552**	**100.0**	**20,488**	**100.0**	**41,040**	**100.0**

	Between MD 650 & US 29						Between US 29 & I-95						Total					
	109 - Eastbound		110 - Westbound		Total		113 - Eastbound		114 - Westbound		Total		Eastbound		Westbound		Total	
Hour	Volume	Percent of Total Day	Volume	Percent of Total Day	Volume	Percent of Total Day	Volume	Percent of Total Day	Volume	Percent of Total Day	Volume	Percent of Total Day	Volume	Percent of Total Day	Volume	Percent of Total Day	Volume	Percent of Total Day
0	72	0.37	134	0.69	205	0.53	58	0.38	122	0.77	180	0.58	366	0.38	637	0.66	1,002	0.52
1	40	0	74	0.38	114	0.29	33	0	69	0.44	102	0.33	200	0.21	358	0.37	557	0.29
2	31	0.16	50	0.26	81	0.21	28	0.18	47	0.30	76	0.24	151	0.16	238	0.25	389	0.20
3	46	0.23	48	0.25	94	0.24	45	0.29	43	0.27	88	0.28	216	0.22	233	0.24	448	0.23
4	115	0.59	80	0.41	195	0.50	111	0.72	67	0.42	178	0.57	535	0.55	397	0.41	932	0.48
5	324	1.65	282	1.45	605	1.55	323	2.09	233	1.48	555	1.78	1,552	1.60	1,401	1.45	2,954	1.53
6	872	4.45	939	4.83	1,812	4.64	788	5.10	816	5.19	1,605	5.14	4,141	4.28	4,577	4.74	8,718	4.51
7	1,796	9.17	2,001	10.28	3,797	9.72	1,444	9.33	1,638	10.41	3,081	9.87	8,609	8.90	9,786	10.14	18,395	9.52
8	**1,986**	**10.14**	**2,298**	**11.81**	**4,284**	**10.97**	**1,485**	**9.60**	**1,793**	**11.39**	**3,277**	**10.50**	**9,430**	**9.75**	**11,666**	**12.09**	**21,095**	**10.92**
9	1,387	7.08	1,567	8.05	2,954	7.56	1,090	7.04	1,214	7.71	2,304	7.38	6,610	6.83	7,901	8.19	14,511	7.51
10	935	4.87	860	4.42	1,815	4.65	785	5.08	660	4.23	1,454	4.66	4,576	4.73	4,392	4.55	8,968	4.64
11	852	4.35	703	3.61	1,555	3.98	705	4.55	548	3.48	1,253	4.01	4,111	4.25	3,575	3.70	7,686	3.98
12	859	4.38	712	3.66	1,571	4.02	707	4.57	559	3.55	1,263	4.06	4,188	4.33	3,594	3.72	7,781	4.03
13	866	4.42	722	3.71	1,588	4.07	716	4.63	572	3.64	1,289	4.13	4,261	4.41	3,643	3.77	7,904	4.09
14	1,098	5.60	841	4.32	1,939	4.96	884	5.71	686	4.36	1,569	5.03	5,436	5.62	4,235	4.39	9,671	5.00
15	1,439	7.35	1,076	5.53	2,516	6.44	1,093	7.06	916	5.82	2,009	6.44	7,133	7.37	5,461	5.66	12,594	6.52
16	1,650	8.42	1,412	7.26	3,062	7.84	1,244	8.04	1,186	7.54	2,430	7.79	8,342	8.62	7,069	7.32	15,411	7.98
17	**1,761**	**8.99**	**1,762**	**9.06**	**3,524**	**9.02**	**1,333**	**8.62**	**1,396**	**8.87**	**2,729**	**8.75**	**9,245**	**9.56**	**8,607**	**8.92**	**17,852**	**9.24**
18	1,381	7.05	1,438	7.39	2,819	7.22	1,025	6.63	1,162	7.38	2,187	7.01	7,054	7.29	6,963	7.21	14,017	7.25
19	802	4.09	837	4.30	1,639	4.20	606	3.92	668	4.24	1,274	4.08	4,087	4.23	4,028	4.17	8,115	4.20
20	495	2.53	561	2.88	1,057	2.71	378	2.44	453	2.88	830	2.66	2,543	2.63	2,711	2.81	5,254	2.72
21	373	1.90	474	2.43	846	2.17	282	1.82	382	2.43	665	2.13	1,934	2.00	2,275	2.36	4,209	2.18
22	250	1.28	356	1.83	606	1.55	193	1.25	299	1.90	492	1.58	1,281	1.32	1,678	1.74	2,959	1.53
23	143	0.73	233	1.20	376	0.96	115	0.75	200	1.27	315	1.01	723	0.75	1,092	1.13	1,815	0.94
Total Day	**19,592**	**100.0**	**19,459**	**100.0**	**39,051**	**100.0**	**15,470**	**100.0**	**15,736**	**100.0**	**31,205**	**100.0**	**96,724**	**100.0**	**96,514**	**100.0**	**193,238**	**100.0**

Source: MDTA

Table 2-9
FY 2014 Average Annual Weekend Hourly Traffic Variations

	Between I-370 & MD 97						Between MD 97 & MD 182						Between MD 182 & MD 650					
	101 - Eastbound		102 - Westbound		Total		105 - Eastbound		106 - Westbound		Total		107 - Eastbound		108 - Westbound		Total	
Hour	Volume	Percent of Total Day	Volume	Percent of Total Day	Volume	Percent of Total Day	Volume	Percent of Total Day	Volume	Percent of Total Day	Volume	Percent of Total Day	Volume	Percent of Total Day	Volume	Percent of Total Day	Volume	Percent of Total Day
0	196	1.48	245	1.82	442	1.65	176	1.42	258	2.05	434	1.74	173	1.37	272	2.17	445	1.77
1	111	0.84	145	1.07	256	0.96	101	0.82	158	1.25	259	1.03	101	0.80	168	1.34	269	1.07
2	66	0.50	97	0.72	164	0.61	63	0.51	109	0.87	172	0.69	65	0.51	116	0.92	180	0.72
3	50	0.38	68	0.50	118	0.44	49	0.40	72	0.57	122	0.49	54	0.43	78	0.62	132	0.52
4	57	0.43	56	0.42	114	0.42	62	0.50	56	0.45	118	0.47	68	0.54	60	0.48	128	0.51
5	106	0.80	95	0.71	201	0.75	119	0.96	88	0.70	207	0.83	128	1.02	90	0.72	218	0.87
6	210	1.58	196	1.45	406	1.52	223	1.79	177	1.41	400	1.60	243	1.93	169	1.34	412	1.64
7	356	2.68	335	2.48	691	2.58	366	2.95	294	2.34	660	2.64	388	3.08	281	2.23	669	2.66
8	527	3.98	510	3.78	1,037	3.88	526	4.23	448	3.55	973	3.89	561	4.45	424	3.37	985	3.91
9	721	5.44	662	4.90	1,383	5.17	703	5.66	570	4.52	1,273	5.09	737	5.85	543	4.32	1,280	5.09
10	867	6.55	771	5.70	1,638	6.12	845	6.81	662	5.25	1,507	6.02	871	6.91	633	5.04	1,504	5.98
11	915	6.91	854	6.32	1,769	6.61	893	7.20	738	5.86	1,632	6.53	918	7.29	712	5.66	1,630	6.48
12	977	7.37	948	7.02	1,924	7.19	**932**	**7.51**	830	6.59	1,762	7.04	**950**	**7.54**	807	6.42	1,757	6.98
13	993	7.50	975	7.22	1,968	7.35	927	7.47	858	6.81	1,785	7.14	935	7.42	841	6.69	1,775	7.05
14	**995**	**7.51**	966	7.15	1,962	7.33	932	7.50	878	6.97	1,810	7.24	933	7.40	872	6.93	1,804	7.17
15	994	7.50	999	7.39	1,992	7.45	909	7.32	935	7.42	1,845	7.37	908	7.21	937	7.45	1,844	7.33
16	992	7.49	**1,014**	**7.51**	**2,007**	**7.50**	897	7.23	964	7.65	**1,862**	**7.44**	892	7.09	969	7.71	**1,861**	**7.40**
17	938	7.08	1,004	7.43	1,941	7.25	854	6.88	**971**	**7.70**	1,825	7.29	851	6.76	**976**	**7.77**	1,827	7.26
18	827	6.24	906	6.70	1,732	6.48	744	5.99	879	6.98	1,623	6.49	740	5.87	884	7.04	1,624	6.45
19	675	5.09	743	5.50	1,418	5.30	603	4.86	724	5.75	1,327	5.31	601	4.78	736	5.85	1,337	5.31
20	568	4.29	630	4.66	1,198	4.48	516	4.15	618	4.90	1,133	4.53	510	4.05	635	5.05	1,145	4.55
21	463	3.50	526	3.89	989	3.70	407	3.27	526	4.18	933	3.73	403	3.20	547	4.35	950	3.77
22	380	2.87	436	3.23	816	3.05	338	2.72	444	3.52	781	3.12	334	2.66	464	3.69	799	3.17
23	262	1.98	328	2.43	590	2.21	232	1.87	341	2.70	573	2.29	230	1.83	359	2.85	589	2.34
Total Day	**13,246**	**100.0**	**13,510**	**100.0**	**26,756**	**100.0**	**12,419**	**100.0**	**12,597**	**100.0**	**25,016**	**100.0**	**12,595**	**100.0**	**12,570**	**100.0**	**25,166**	**100.0**

	Between MD 650 & US 29						Between US 29 & I-95						Total					
	109 - Eastbound		110 - Westbound		Total		113 - Eastbound		114 - Westbound		Total		Eastbound		Westbound		Total	
Hour	Volume	Percent of Total Day	Volume	Percent of Total Day	Volume	Percent of Total Day	Volume	Percent of Total Day	Volume	Percent of Total Day	Volume	Percent of Total Day	Volume	Percent of Total Day	Volume	Percent of Total Day	Volume	Percent of Total Day
0	161	1.31	269	2.22	429	1.76	125	1.24	229	2.34	354	1.79	831	1.37	1,274	2.10	2,105	1.74
1	94	0.77	166	1.37	260	1.07	74	0.73	145	1.49	219	1.10	482	0.79	781	1.29	1,263	1.04
2	61	0.50	116	0.96	177	0.73	50	0.50	105	1.08	155	0.78	306	0.50	543	0.90	849	0.70
3	54	0.44	77	0.61	131	0.54	47	0.47	74	0.76	121	0.61	254	0.42	369	0.61	623	0.51
4	71	0.58	58	0.48	129	0.53	67	0.67	53	0.55	121	0.61	326	0.54	284	0.47	610	0.50
5	128	1.04	88	0.73	217	0.89	125	1.23	78	0.79	202	1.02	605	1.00	439	0.73	1,045	0.86
6	247	2.01	157	1.30	404	1.66	233	2.31	128	1.31	361	1.82	1,155	1.90	827	1.37	1,982	1.64
7	396	3.22	263	2.18	659	2.70	334	3.31	214	2.19	548	2.76	1,839	3.03	1,387	2.29	3,227	2.66
8	560	4.55	392	3.24	952	3.90	470	4.66	298	3.06	768	3.87	2,643	4.36	2,073	3.42	4,716	3.89
9	724	5.89	502	4.16	1,227	5.03	603	5.98	377	3.86	980	4.94	3,488	5.75	2,654	4.38	6,142	5.07
10	853	6.94	598	4.95	1,451	5.95	717	7.11	450	4.61	1,167	5.88	4,133	6.83	3,134	5.18	7,267	6.00
11	910	7.40	667	5.52	1,577	6.47	759	7.52	504	5.16	1,263	6.36	4,397	7.25	3,473	5.74	7,871	6.50
12	**936**	**7.62**	757	6.26	1,693	6.94	**776**	**7.69**	576	5.89	1,351	6.81	**4,571**	**7.54**	3,917	6.47	8,487	7.00
13	919	7.48	795	6.58	1,715	7.03	761	7.54	621	6.36	1,381	6.96	4,535	7.48	4,089	6.76	8,624	7.12
14	914	7.44	835	6.91	1,749	7.17	747	7.40	667	6.83	1,413	7.12	4,521	7.45	4,218	6.97	8,739	7.21
15	882	7.17	905	7.48	1,787	7.33	708	7.02	737	7.54	1,444	7.28	4,400	7.26	4,512	7.45	8,912	7.35
16	859	6.99	942	7.79	**1,801**	**7.39**	687	6.81	774	7.93	**1,461**	**7.36**	4,328	7.14	4,663	7.70	**8,991**	**7.42**
17	820	6.67	**954**	**7.89**	1,773	7.27	656	6.50	**785**	**8.04**	1,441	7.26	4,118	6.79	**4,689**	**7.75**	8,807	7.27
18	714	5.80	864	7.14	1,577	6.47	572	5.67	716	7.33	1,288	6.49	3,596	5.93	4,249	7.02	7,844	6.47
19	581	4.72	717	5.93	1,298	5.32	464	4.60	602	6.17	1,066	5.37	2,924	4.82	3,521	5.82	6,446	5.32
20	490	3.99	621	5.13	1,111	4.56	389	3.85	515	5.27	904	4.55	2,473	4.08	3,018	4.99	5,491	4.53
21	386	3.14	536	4.43	922	3.78	303	3.01	443	4.54	747	3.76	1,962	3.24	2,578	4.26	4,540	3.75
22	317	2.58	459	3.79	776	3.18	249	2.47	379	3.89	629	3.17	1,619	2.67	2,182	3.60	3,801	3.14
23	217	1.76	354	2.93	571	2.34	171	1.70	294	3.01	465	2.34	1,112	1.83	1,676	2.77	2,789	2.30
Total Day	**12,294**	**100.0**	**12,092**	**100.0**	**24,386**	**100.0**	**10,085**	**100.0**	**9,765**	**100.0**	**19,849**	**100.0**	**60,639**	**100.0**	**60,534**	**100.0**	**121,173**	**100.0**

Source: MDTA

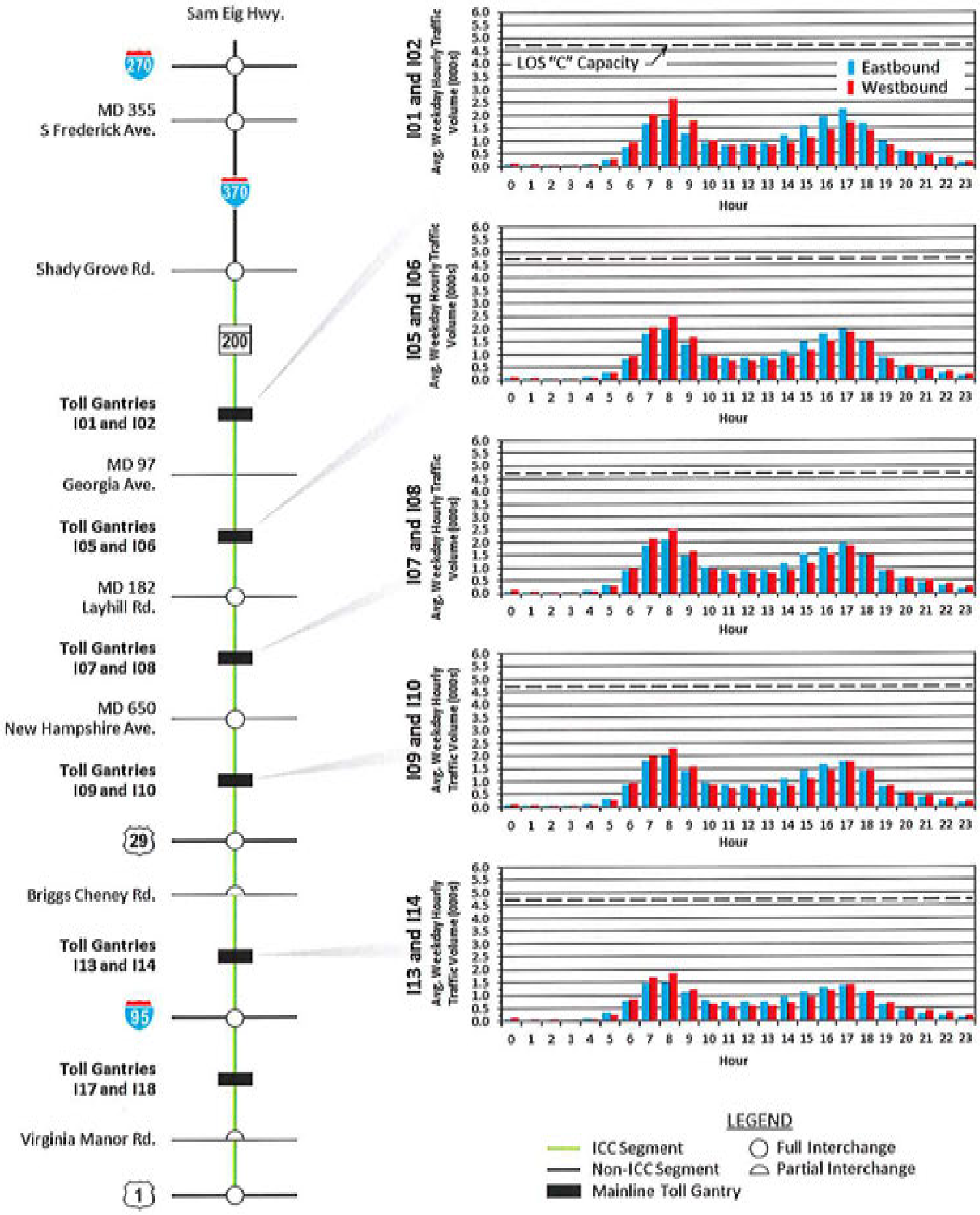


Figure 2-12
FY 2014 Average Weekday Hourly Traffic Variations by Mainline Toll Location

Table 2-10
Transactions by Vehicle Class and Payment Type
FY 2011 – FY 2016

Passenger Cars

Fiscal Year	E-ZPass® Transactions	Percent of PC	Percent of Total E-Zpass® Transactions	Video Transactions	Percent of PC	Percent of Total Video Transactions	Total
FY 2011[1]	1,085,980	68.6	96.1	497,237	31.4	97.2	1,583,217
FY 2012[2]	22,494,869	80.7	97.1	5,364,965	19.3	98.1	27,859,834
FY 2013	43,323,816	84.9	96.9	7,727,238	15.1	97.3	51,051,054
FY 2014	51,330,718	83.8	97.0	9,916,757	16.2	97.3	61,247,475
FY 2015[3]	60,413,491	82.9	97.1	12,431,566	17.1	96.6	72,845,057
FY 2016[4][5]	17,374,214	81.4	97.0	3,965,822	18.6	96.7	21,340,036

Commercial Vehicles

Fiscal Year	E-ZPass® Transactions	Percent of CV	Percent of Total E-Zpass® Transactions	Video Transactions	Percent of CV	Percent of Total Video Transactions	Total
FY 2011[1]	43,679	75.0	3.9	14,577	25.0	2.8	58,256
FY 2012[2]	673,058	86.6	2.9	104,372	13.4	1.9	777,430
FY 2013	1,366,962	86.6	3.1	211,067	13.4	2.7	1,578,029
FY 2014	1,565,044	84.8	3.0	280,364	15.2	2.7	1,845,408
FY 2015[3]	1,832,295	80.5	2.9	443,080	19.5	3.4	2,275,375
FY 2016[4][5]	537,261	79.7	3.0	136,897	20.3	3.3	674,158

Total Transactions

Fiscal Year	E-ZPass® Transactions	Percent of CV	Percent of Total E-Zpass® Transactions	Video Transactions	Percent of CV	Percent of Total Video Transactions	Total
FY 2011[1]	1,129,659	68.8	100.0	511,814	31.2	100.0	1,641,473
FY 2012[2]	23,167,927	80.9	100.0	5,469,337	19.1	100.0	28,637,264
FY 2013	44,690,778	84.9	100.0	7,938,305	15.1	100.0	52,629,083
FY 2014	52,895,762	83.8	100.0	10,197,121	16.2	100.0	63,092,883
FY 2015[3]	62,245,786	82.9	100.0	12,874,646	17.1	100.0	75,120,432
FY 2016[4][5]	17,911,475	81.4	100.0	4,102,719	18.6	100.0	22,014,194

Source: MDTA, Traffic by Payment Type Reports 2011-2015

Note: Percentages based on total transactions and have not been adjusted to accoutn for ITOLL or VTOLL transactions.

[1] Toll Gantries I01-I02 opened in February 2011, and were the only gantries open in FY2011.

[2] Toll Gantries I05-I06, I07-I08, I09-I10, and I13-I14 opened in November 2011, FY2012.

[3] Toll Plazas I17/I18 opened in November 2014, FY2015.

[4] Toll Rates were decreased effective July 2015, FY2016

[5] FY2016 data includes data from July - September 2015.

2.7 Trends in Method of Toll Payment

Table 2-11 provides a summary of E-ZPass® market share rates by ICC toll gantry since the opening of the facility in FY 2011. In the first year of operation, only 68.8 percent of the road's users used E-ZPass®. This increased to a total of 84.9 percent system-wide by FY 2013. This figure had decreased to 83.8 percent system-wide by FY 2014. Gantries on the western end of the system tend to have individual E-ZPass® shares near the system-wide average, while gantries I13 and I14 have lower than average market shares, at only 81.8 percent in FY 2014.

Between FY 2013 and FY 2016, total system-wide E-ZPass® participation has decreased from 84.9 percent to 81.4 percent. However, this is not due to a shift of E-ZPass® customers to video tolling, since E-ZPass® transactions have increased every year since the opening of the ICC. Instead, the decrease in E-ZPass® participation is due to the faster growth of video transactions. This indicates that new users are more likely to use video tolling, a trend currently being observed at many other toll facilities offering video tolling across the nation. This may be the result of various different factors. First, new users may be more infrequent and for this reason may be less willing to deal with the time or expense of obtaining a transponder. Second, toll differentials may not currently be significant enough to encourage new users to obtain an ETC transponder in light of their more infrequent roadway use. Lastly, it should be noted that, while E-ZPass® express lanes offered potential time savings over traditional cash toll plazas, there is no difference in travel time savings between E-ZPass® and video tolling. As a result, new customers may not have the same incentive to obtain a transponder as they did before the advent of video tolling.

2.8 Distribution of ICC Customers by Zip Code

Figure 2-13 shows the average number of weekday trips by Maryland E-ZPass® customers by customer zip code in FY 2014. Zip codes immediately adjacent to the ICC corridor show the most usage at over 500 trips per weekday. In the surrounding areas of metropolitan Washington, D.C., and Baltimore, MD, ICC E-ZPass® usage averages between 51 and 100 transactions a day. The remainder of Maryland, as well as the city of Washington, D.C., and Virginia show much less usage, at single digit daily uses per zip code.

2.9 Travel Times and Speeds

INRIX speed data and travel time data have been collected on numerous travel routes in the vicinity of the ICC, including the facility itself. Travel speeds, congestion levels, and potential time savings are important inputs for successful model calibration and assist in producing reliable traffic forecasts.

2.9.1 INRIX Speed Data

INRIX speed data captures actual speed conditions on roadways by using mobile GPS devices located in cellular devices and other media. Within the project area, INRIX speed data were available by roadway segment in 5-minute intervals on a variety of roadways. **Figure 2-14** shows all the roadways in which INRIX speed data were available within the study area for FY 2014.

2.9.2 Observed Speeds and Travel Times

Auxiliary travel time runs were conducted by CDM Smith in conjunction with the INRIX speed data to serve as an additional data source in determining the accuracy of local travel times. Vehicle runs were made on major competing roadways during peak and off-peak conditions using GPS technology to

Table 2-11
Transactions by Method of Toll Payment
FY 2011 – FY 2016

Toll Gantry	E-Zpass* Annual Transactions (000s)	E-Zpass* Percent of Total	Video Toll Annual Transactions (000s)	Video Toll Percent of Total	Total Transactions (000s)
Toll Gantries I01-I02					
FY 2011[1]	1,129.7	68.8	511.8	31.2	1,641.5
FY 2012[2]	6,600.0	82.3	1,417.8	17.7	8,017.8
FY 2013	9,887.3	85.1	1,732.0	14.9	11,619.3
FY 2014	11,422.6	84.3	2,127.8	15.7	13,550.4
FY 2015[3]	12,895.0	83.4	2,559.5	16.6	15,454.4
FY 2016[4][5]	3,576.6	82.0	785.2	18.0	4,361.8
Toll Gantries I05-I06					
FY 2012[2]	4,501.8	80.7	1,076.8	19.3	5,578.6
FY 2013	9,395.9	85.2	1,631.8	14.8	11,027.6
FY 2014	11,178.6	84.5	2,047.9	15.5	13,226.5
FY 2015[3]	12,879.6	83.7	2,511.0	16.3	15,390.6
FY 2016[4][5]	3,640.0	82.4	775.9	17.6	4,415.9
Toll Gantries I07-I08					
FY 2012[2]	4,532.7	81.3	1,042.1	18.7	5,574.8
FY 2013	9,401.7	85.1	1,641.3	14.9	11,043.1
FY 2014	11,199.5	84.4	2,070.4	15.6	13,269.9
FY 2015[3]	12,951.1	83.4	2,577.1	16.6	15,528.2
FY 2016[4][5]	3,672.3	82.0	808.0	18.0	4,480.3
Toll Gantries I09-I10					
FY 2012[2]	4,207.9	80.6	1,015.5	19.4	5,223.4
FY 2013	8,911.1	85.1	1,559.1	14.9	10,470.2
FY 2014	10,645.0	83.7	2,068.1	16.3	12,713.1
FY 2015[3]	12,449.4	82.9	2,569.6	17.1	15,019.1
FY 2016[4][5]	3,565.6	81.6	803.8	18.4	4,369.4
Toll Gantries I13-I14					
FY 2012[2]	3,325.5	78.4	917.1	21.6	4,242.6
FY 2013	7,094.8	83.8	1,374.1	16.2	8,468.9
FY 2014	8,450.1	81.8	1,882.8	18.2	10,332.9
FY 2015[3]	10,078.8	81.1	2,343.4	18.9	12,422.2
FY 2016[4][5]	2,942.5	79.7	749.5	20.3	3,692.0
Toll Gantries I17-I18[4]					
FY 2015[3]	991.8	76.0	314.0	24.0	1,305.9
FY 2016[4][5]	514.4	74.0	180.4	26.0	694.9
Total System					
FY 2011[1]	1,129.7	68.8	511.8	31.2	1,641.5
FY 2012[2]	23,167.9	80.9	5,469.3	19.1	28,637.3
FY 2013	44,690.8	84.9	7,938.3	15.1	52,629.1
FY 2014	52,895.8	83.8	10,197.1	16.2	63,092.9
FY 2015[3]	62,245.8	82.9	12,874.6	17.1	75,120.4
FY 2016[4][5]	17,911.5	81.4	4,102.7	18.6	22,014.2

Source: MDTA, Traffic by Payment Type Reports 2011-2015

Note: Percentages based on total transactions and have not been adjusted to accoutn for ITOLL or VTOLL transactions.

Trips on ICC were toll-free from February 23 to March 7 and from November 22 to December 4, 2011 as new segments of the road opened.

[1] Toll Gantries I01-I02 opened in February 2011, and were the only gantries open in FY2011.

[2] Toll Gantries I05-I06, I07-I08, I09-I10, and I13-I14 opened in November 2011, FY2012.

[3] Toll Plazas I17/I18 opened in November 2014, FY2015.

[4] Toll Rates were decreased effective July 2015, FY2016

[5] FY2016 data includes data from July - September 2015.

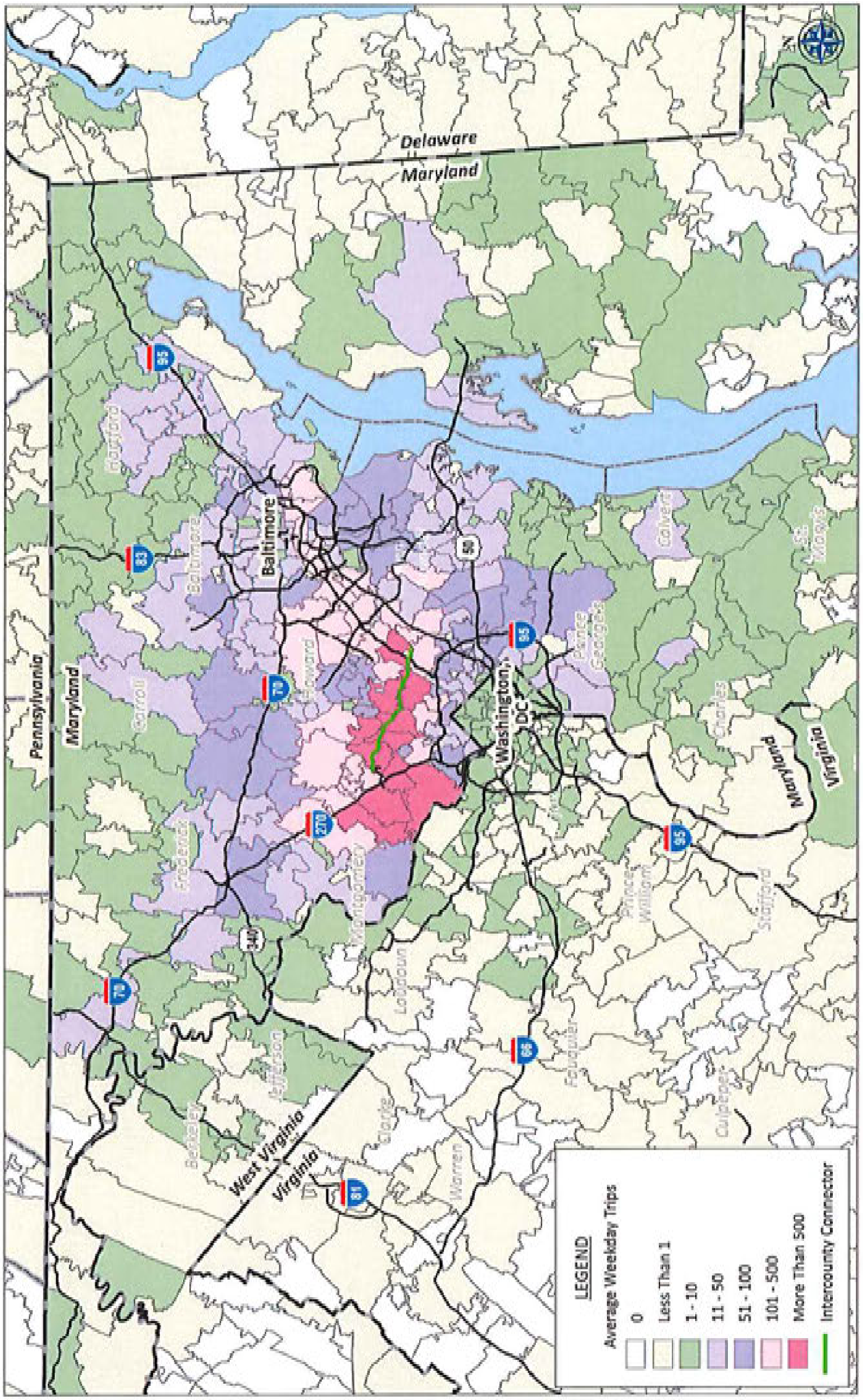


Figure 2-13
FY 2014 Average Weekday Trips Made by ICC E-ZPass® Customers by Zip Code

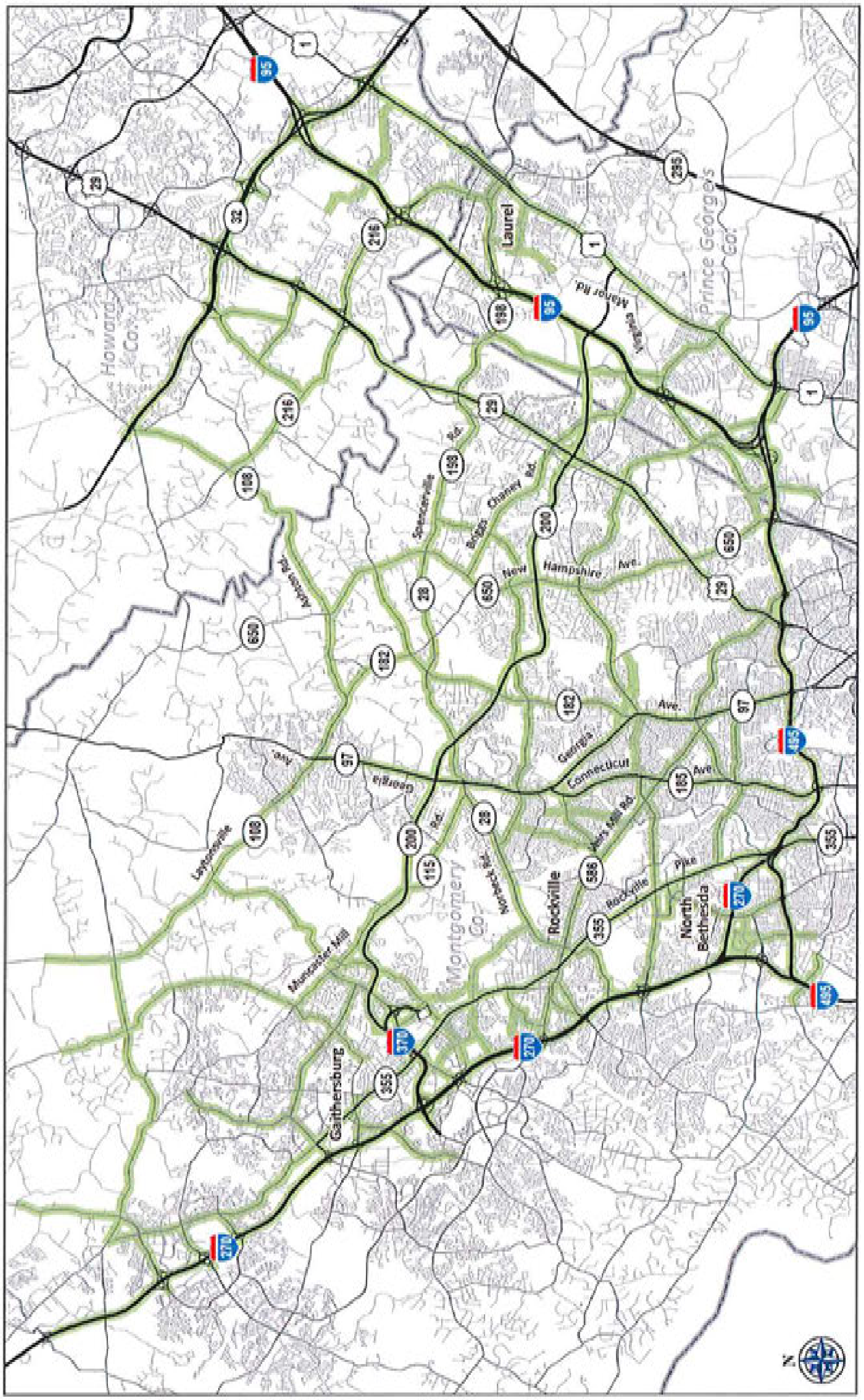


Figure 2-14
INRIX Speed Data Coverage Area

determine location and speed. **Figure 2-15** illustrates the routes that travel time runs were conducted between September 29 and October 1, 2014.

Figure 2-16 details the free-flow travel times on given segments across the ICC study area. The green route shows the travel time on the ICC corridor, while other colors show travel times for alternative routes. At free-flow conditions, a full trip on the ICC takes roughly 17 minutes. By using the non-tolled interstates, a full trip can be completed in roughly 24.5 minutes during free-flow conditions. This calculation assumes a full trip is from I-270 at I-370 to I-95 at ICC. This makes the full alternate highway route approximately 7.5 minutes longer than using the ICC. All other alternate routes shown have a higher free-flow travel time than the ICC.

Figure 2-17 shows the same routes but with AM Peak Period travel times. The travel times on the ICC remain virtually the same as those under free-flow conditions, at around 17 minutes, as there is no congestion on the road. However, all the alternative routes show increased travel times, including a jump in travel times on the interstate route. Specifically, using the non-tolled interstates, a full trip can be completed in 30 to 38 minutes during AM Peak Period travel conditions for a complete diversion of the ICC. The fastest east-west arterial route is via Randolph Road, taking roughly 30 minutes to complete a comparable trip between I-290 and I-95. This clearly makes the ICC the fastest east-west route between I-290 and I-95 during the AM Peak. The same can be said for travel during the PM Peak Period, as shown in **Figure 2-18**. As illustrated in the figure, the ICC maintains travel speeds near free-flow conditions while all other routes experience travel time increases. On the non-tolled interstates, a full trip can be completed in roughly 30 minutes during PM Peak Period travel conditions for a complete diversion of the ICC. The fastest east-west arterial route is Randolph Road, taking almost 30 minutes to complete a comparable trip between I-290 and I-95. It should be noted that this data reflects average travel time savings. Considerably more time savings are likely provided by the ICC during higher levels of traffic experienced in the area during certain months, weeks, and days throughout the year, including when there are accidents and construction activity on alternate routes.

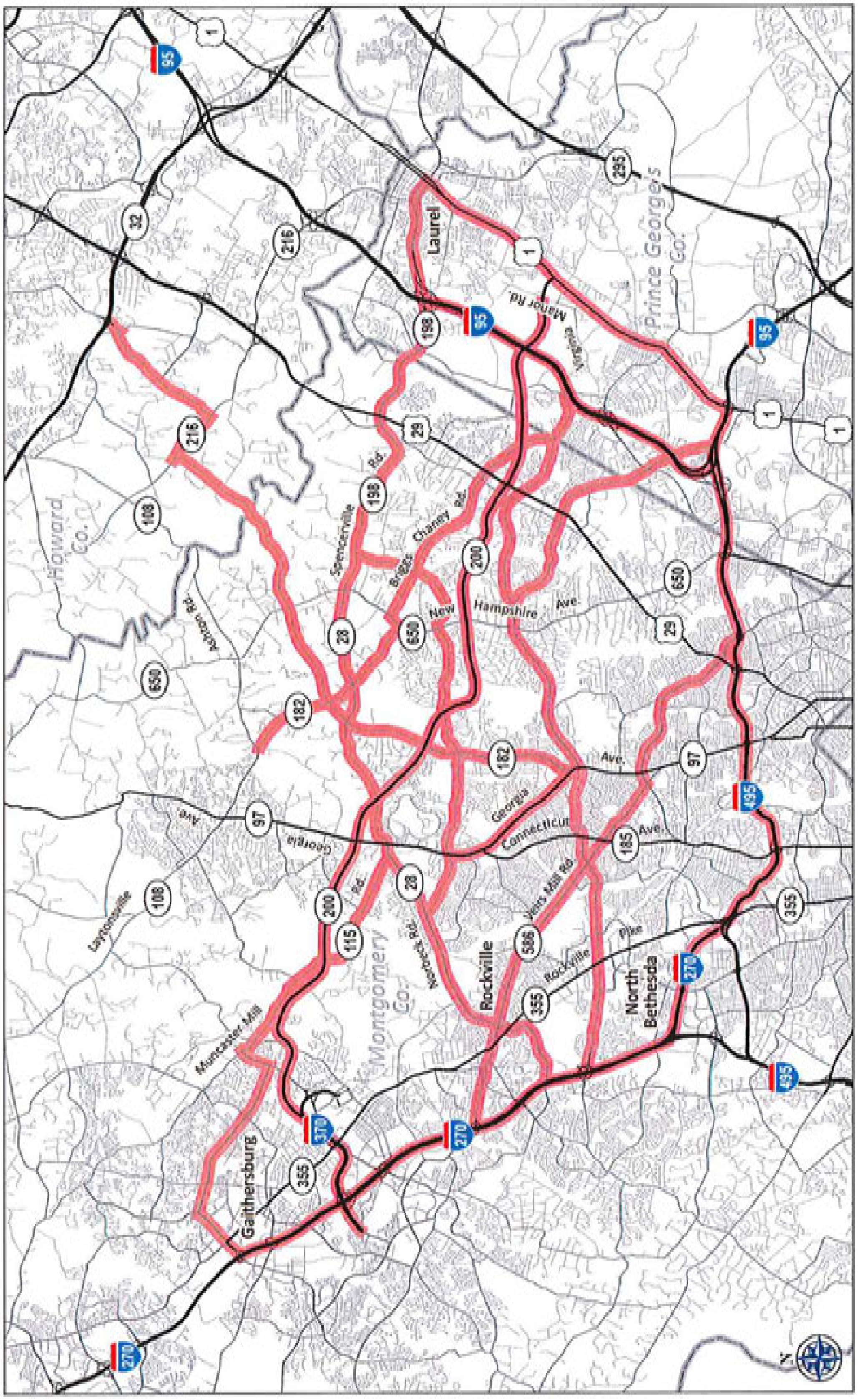


Figure 2-15
CDM Smith Travel Time Routes

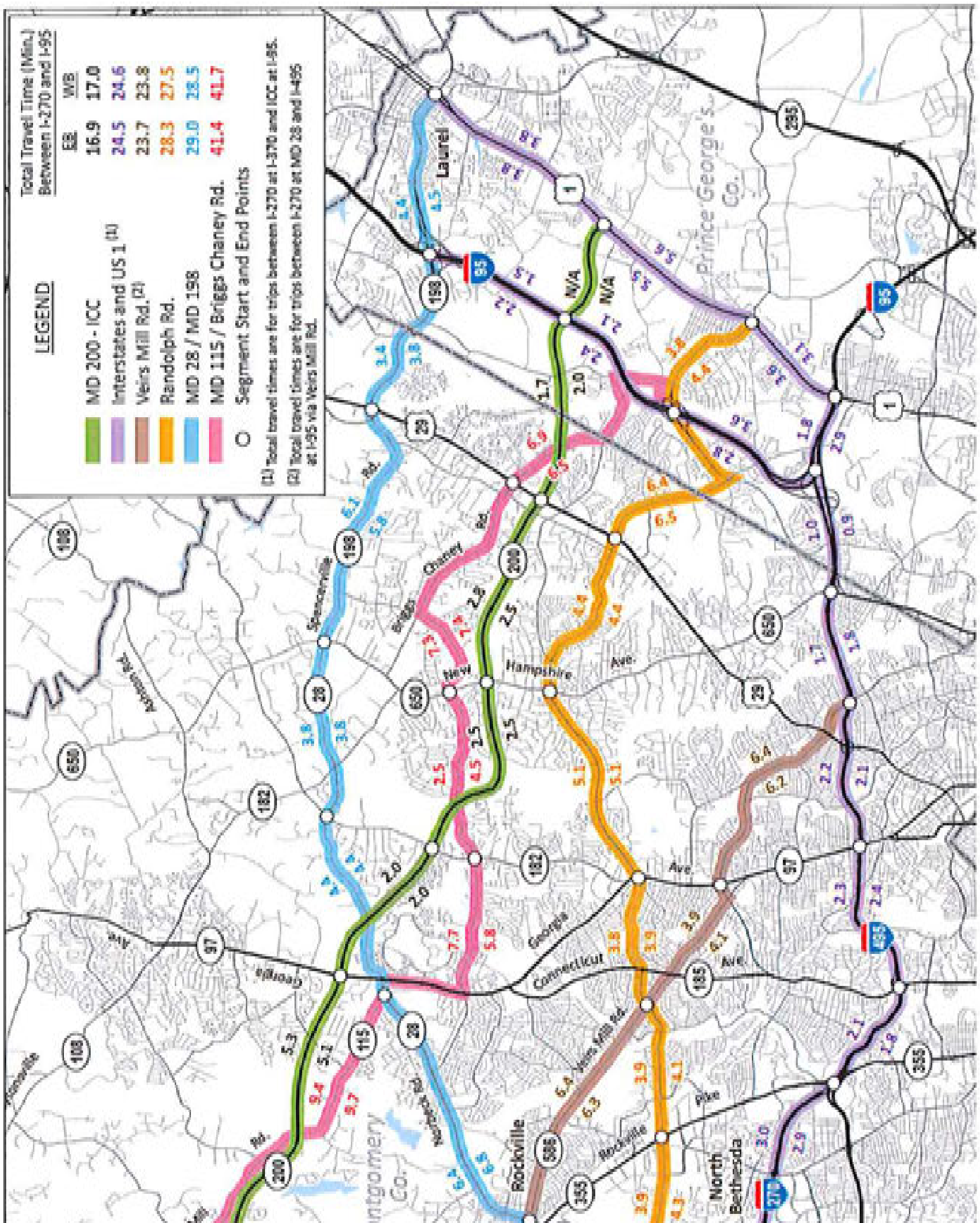


Figure 2-16
FY 2014 Free-Flow Travel Times in the Intercounty Connector Corridor

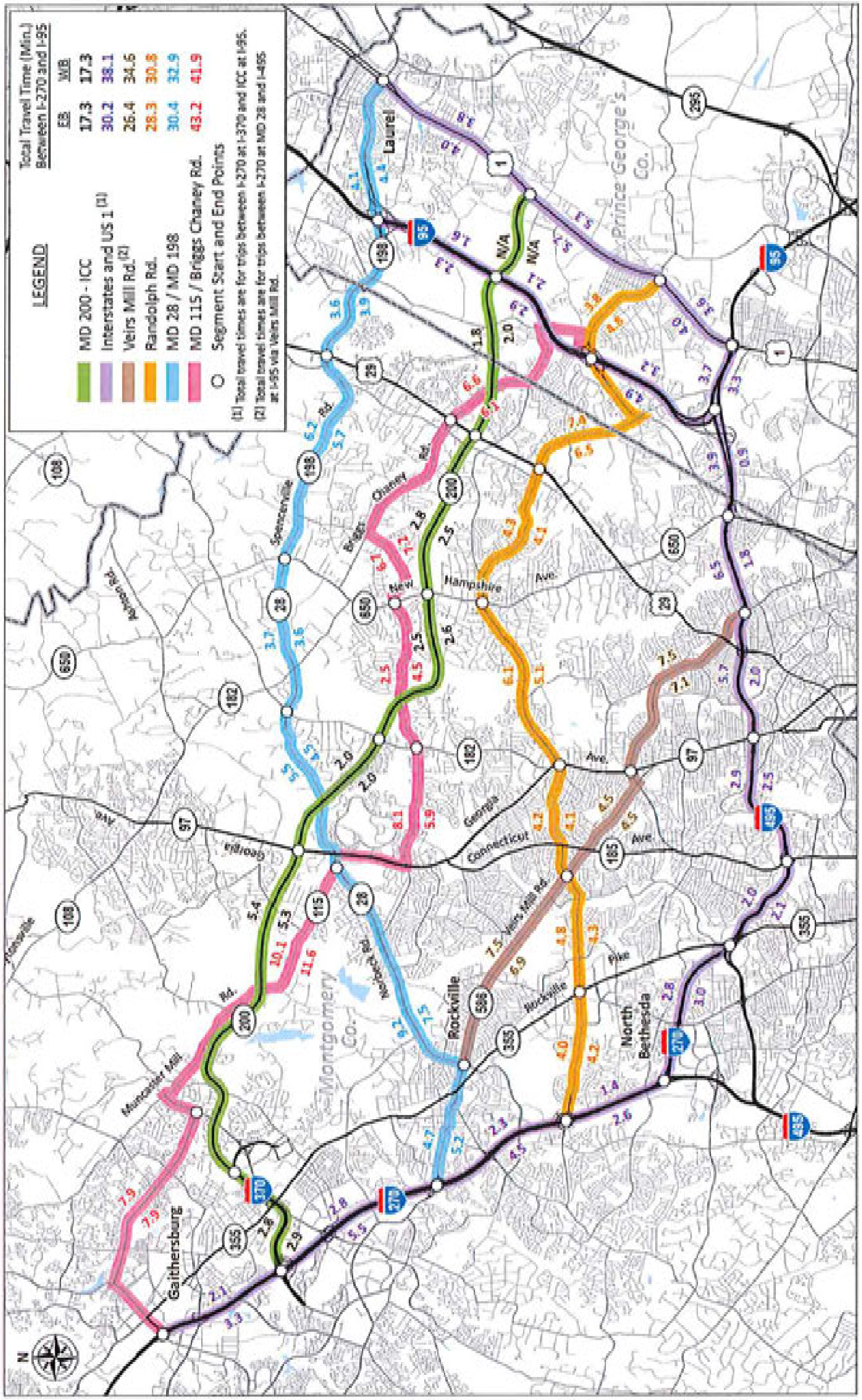


Figure 2-17
FY 2014 AM Peak Period Travel Times in the Intercounty Connector Corridor

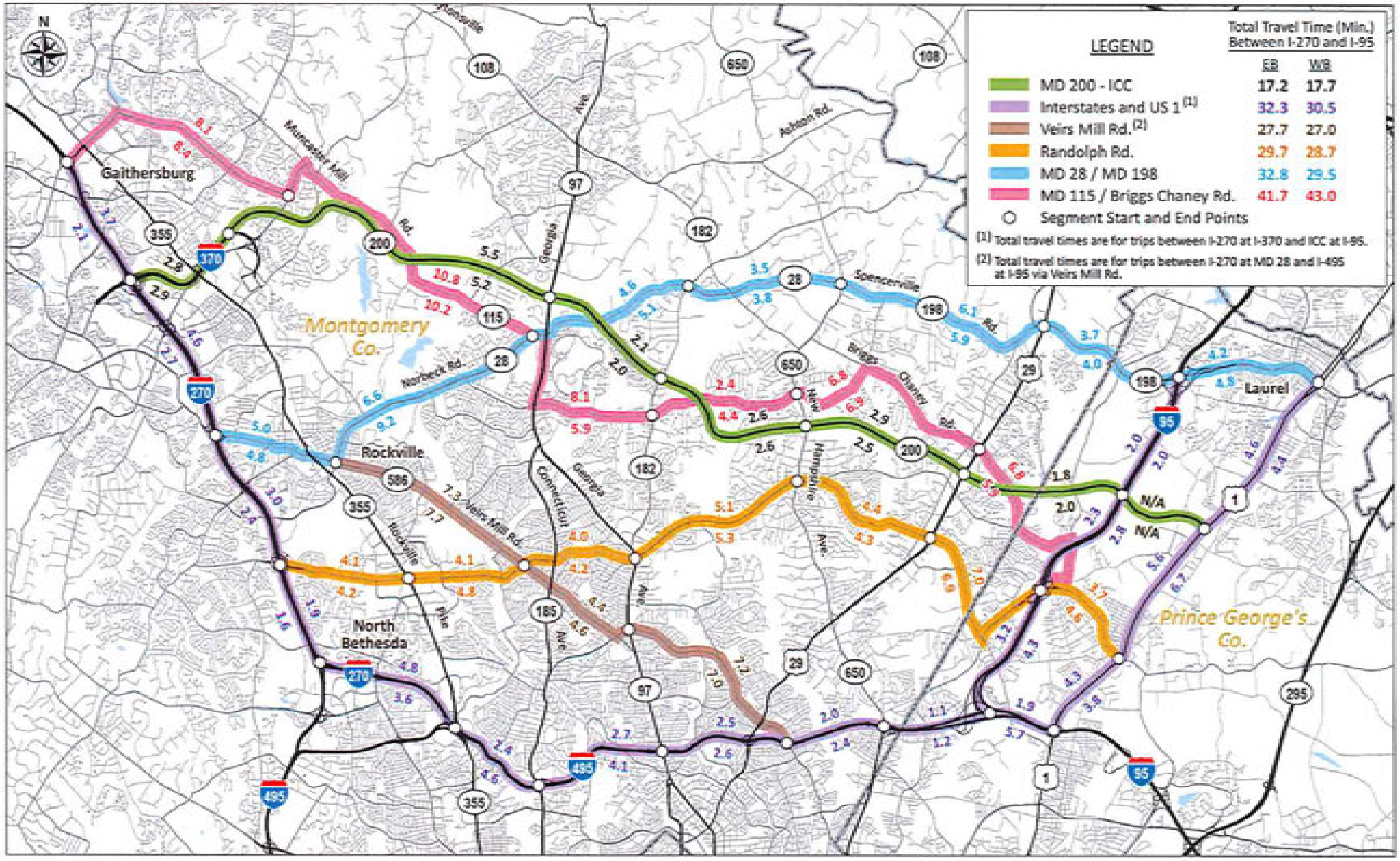


Figure 2-18

FY 2014 PM Peak Period Travel Times in the Intercounty Connector Corridor

Chapter 3

Stated Preference Surveys

In February and March 2015, Resource Systems Group, Inc. (RSG) conducted a stated preference survey for drivers who make trips that use, or could potentially use, the Intercounty Connector (ICC). The primary purpose of the survey was to determine the willingness of travelers to pay for travel time savings, or value of time (VOT), in the study region. CDM Smith incorporated the VOT estimates into the project travel demand model that was used to forecast traffic and toll revenue for the ICC.

This chapter summarizes the results of the stated preference survey report. A copy of the technical details of the survey, along with survey tabulations, is included in **Appendix A**.

3.1 Survey Approach and Administration

RSG designed a survey questionnaire for participating automobile travelers who recently made a trip in the region served by the ICC. The questionnaire asked for information on current travel behaviors and used stated preference experiments based on survey participant responses to estimate travelers' VOT under a range of conditions. The survey approach employed a computer-assisted self-interview technique for survey participants developed by RSG. The stated preference survey instrument was customized for each respondent by presenting questions and modifying wording based on respondents' previous answers. These dynamic survey features provided an accurate and efficient means of data collection and allowed presentation of realistic future conditions that corresponded with respondents' reported experiences. The customized, proprietary software was programmed by RSG and administered online to specific target audiences in the study region. RSG began the survey administration on February 6, 2015 and concluded on March 2, 2015.

RSG worked closely with the project team to develop an efficient, timely, and cost-effective sampling plan to ensure representation from all key travel markets served by the ICC. The survey was administered online to travelers using three outreach methods in order to maximize survey participation. (1) Email invitations were sent to E-ZPass® account holders residing in ZIP codes within the study area. (2) In-person interviews were conducted at locations along the ICC corridor, such as libraries, Department of Motor Vehicle locations and shopping centers, as depicted in **Figure 3-1**. (3) Email invitations were also sent to members of an online market research panel residing in ZIP codes within the study area. These three strategies were employed as part of the sampling plan so as to include sufficient representation from different trip purposes, household incomes, travel times, and geographies to accurately reflect any behavioral differences in the resulting discrete choice models.

Table 3-1 shows the number of survey responses for the three outreach methods. A total of 3,180 respondents completed the survey. From the email invitations sent to E-ZPass® customers residing in ZIP codes within the study area, 2,486 responses were received. Onsite interviews at various locations along the study corridors yielded 369 responses and an online market research panel obtained 325 responses. In total, 215 responses were obtained from Non-ICC users. This sample size and its composition is well above the typical response rate for this type of survey effort and provides a more than adequate sample for use in estimating VOT for trips in the area for both ICC and non-ICC users.

Figure 3-1
In-Person Interview Locations

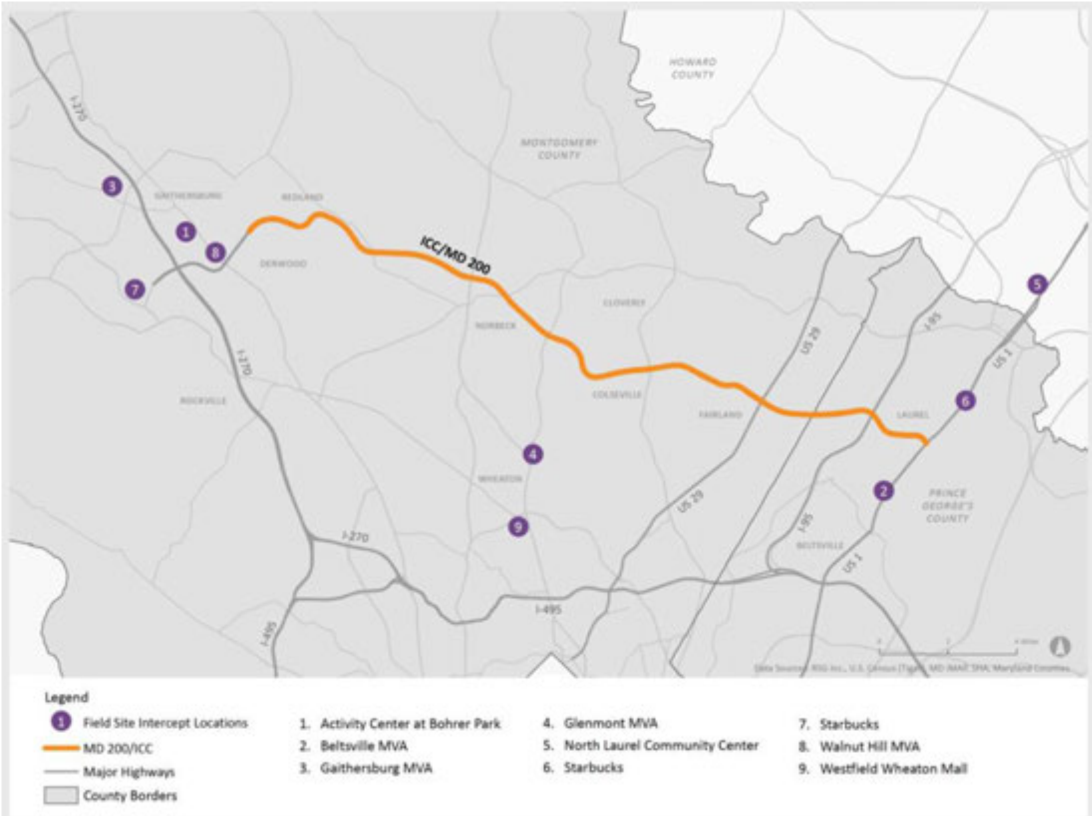


Table 3-1
Completed Surveys Received by Outreach Methodology

Outreach Methodology	Completed Surveys	Percent of Total
E-ZPass® Customers	2,486	78.2
In-Person Interviews	369	11.6
Online Research Panel	325	10.2
Total	**3,180**	**100.0**

3.2 Survey Questionnaire

The survey questionnaire was designed to collect information about a recent trip that a respondent made in the region served by the ICC. The survey questions were grouped into five main sections: (1) introduction and qualification, (2) trip detail, (3) stated preference, (4) debrief and opinion, and (5) demographics.

The complete text of the questionnaire and example survey screens is included in the appendices to the full survey report found in **Appendix A** of this document.

3.2.1 Introduction and Qualification

After being presented with basic instructions and an introduction to the purpose of the study, respondents answered a set of qualification questions. The qualification questions were constructed to classify respondents into one of two groups: (1) Respondents who made a trip in the study area and used the ICC for that trip (ICC users) and (2) Respondents who made a trip in the study area on a competing route that could have potentially used the ICC (potential ICC users).

The first qualification question asked whether the respondent had made a trip within, through or into the study region in the Montgomery County and Prince George's County area that met all of the following conditions:

- Was made within the past month;
- Took at least 10 minutes in total door-to-door travel time; and
- Was made in a personal vehicle (e.g. car, pickup truck, or minivan).

Respondents who indicated that they had not made a trip that met all of these criteria were terminated from the survey. Qualifying respondents were asked to focus on their most recent trip that met all of the screening criteria as they continued through the survey. This most recent trip (referred to as the respondent's reference trip) formed the contextual basis for the rest of the survey.

Respondents who had made a qualifying trip but did not use the ICC were asked the reason for not using the ICC. The following reasons were presented to these respondents:

- Did not want to pay a toll to travel on the ICC;
- The toll for travel on the ICC is not worth travel-time savings;
- Don't have an electronic transponder and/or do not like video tolling;
- It was not convenient to travel on the ICC;
- My trips' beginning and ending locations did not require me to travel on the ICC; and
- Other.

Respondents who chose either of the first two options listed above were asked to focus on their most recent trip that could have used the ICC as their "reference trip" as they continued through the survey. Respondents who selected any of the other options were terminated from the survey.

3.2.2 Trip Detail Questions

Respondents were instructed to think of the one-way portion of their reference trip, rather than their entire round trip. They were asked a series of questions regarding the specific details of this trip, including:

- Day of week traveled;
- Use of ICC on weekdays/weekends (if the respondent is an ICC user);
- Road(s) used (if the respondent is a potential ICC user);

- Reason(s) for using the ICC (if the respondent is an ICC user);
- Trip purpose;
- Entrance and exit ramps (if the respondent is an ICC user);
- Trip departure time;
- Travel time;
- Travel delays due to traffic congestion (if the respondent is a potential ICC user);
- Possible travel time if using the ICC (if the respondent is a potential ICC user);
- Possible travel time if not using the ICC (if the respondent is an ICC user);
- Ownership of Electronic Toll Collection (ETC) device;
- Reason for not having an ETC device (if the respondent does not have ETC device);
- Possible tolls paid (if the respondent is a potential ICC user);
- Vehicle occupancy;
- Trip frequency; and
- Trip flexibility.

In addition, respondents were asked to report where their trip began and ended using a map interface. Respondents provided details about their trip origin and destination by either entering a business name, street intersection, full address or by clicking on the interactive map.

3.2.3 Stated Preference Questions

The stated preference questions were introduced with information on how tolls are collected on the ICC and how toll revenue collected on the ICC is used.

The stated preference questions were designed to construct quantitative experiments to estimate respondents' travel preferences and behavioral responses under hypothetical future conditions. The details of each respondent's reference trip were used to build a set of ten stated preference scenarios that included the following alternatives:

- Make the reference trip using the current route and departure time (potential ICC users) / Make the reference trip using an alternative route at the current departure time (ICC users);
- Make the reference trip on the ICC at the current departure time; and
- (For only those traveling in the peak hours with a flexible departure time), make the reference trip on the ICC outside of the peak.

Each alternative was described by attributes of travel time and toll cost. The third alternative of travel outside the peak included an additional attribute for the duration of the peak. This allowed the respondent to assess by how much they would have to shift their travel time. The values of the attributes varied across the ten questions and respondents were asked to select the alternative they preferred the most. **Figure 3-2** and **Figure 3-3** show examples of stated preference scenarios from the survey with two and three alternatives, respectively. In order to avoid potential bias associated with the layout of the alternatives, the order of the alternatives was randomized for each respondent.

The attribute values presented in each question varied around a set of base values. To ensure that the scenarios were realistic, trip characteristics of each respondent's reference trip were used to calculate the base values for travel time and toll cost. The base values for the attributes were varied by multiplying one of several factors according to the experimental design for that particular scenario. By varying the travel time and toll cost for each alternative shown in each experiment, the respondent was faced with different time savings for different costs, allowing them to demonstrate their travel preferences across a range of values of time.

3.2.4 Debrief and Opinion Questions

After completing the ten stated preference experiments, respondents answered a series of questions to assess possible underlying rationale for their choices and to identify possible strategic bias in their responses.

Respondents who never selected an ICC alternative in the stated preference section were asked to indicate their primary reason for their choices. Additionally, respondents who never selected to change the departure time of their trip were also asked to indicate the primary reason for their choices. Potential ICC users were asked what would make them more likely to use the ICC for a portion of their trips. Finally, all respondents were asked to indicate the level to which they agree or disagree with the following set of statements about tolls:

- I will use a toll route if the tolls are reasonable and I will save time;
- I will use a toll route if it guarantees a reliable travel time;
- I support using tolls or fees to pay for highway improvements that relieve congestion; and
- I support increased or new taxes to pay for highway improvements that relieve congestion.

3.2.5 Demographic Questions

In the final section of the survey, demographic information was collected in order to classify respondents, identify differences in responses among traveler segments, and confirm that the sample contained a diverse group of drivers that travel in the study region. Demographic questions related to home ZIP code, gender, age, employment status, household size, vehicle ownership, and annual household income.

Before finishing the survey, respondents also had the opportunity to leave any comments about the survey or the ICC.

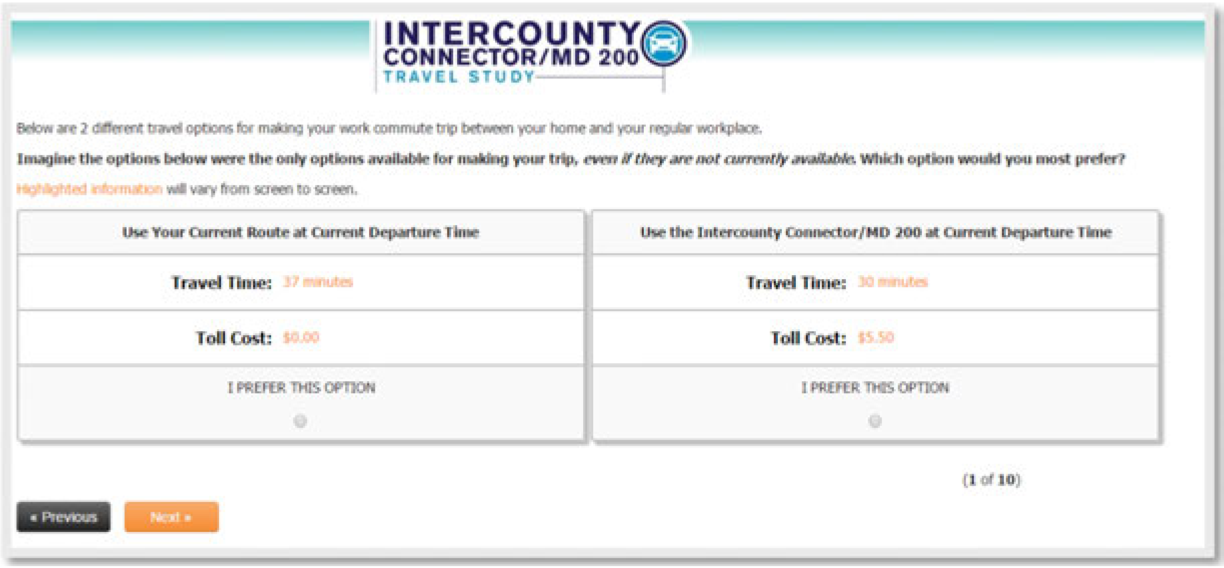


Figure 3-2
Sample Survey Screen with Two Alternatives

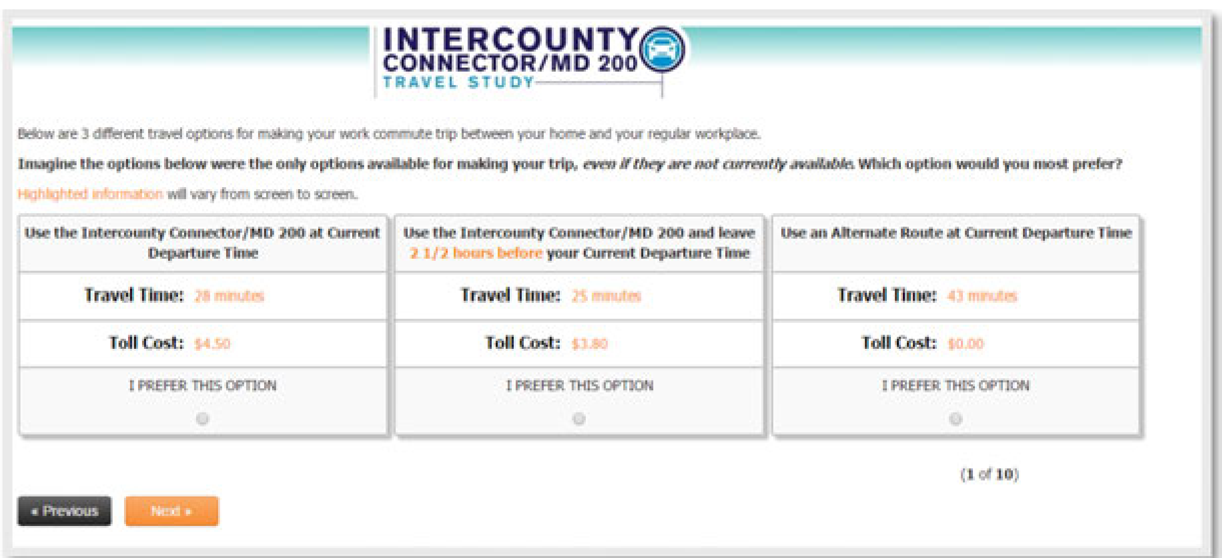


Figure 3-3
Sample Survey Screen with Three Alternatives

3.3 Survey Results

A total of 3,180 respondents completed the stated preference survey. The number of records was reduced to 2,946 after completing typical data checks and outlier analysis during the model estimation work. Several variables were used for these screening purposes, including an examination of the geographical coordinates of the reported trip, inconsistent or irrational choice behavior, implied speed of the reported trip, stated preference and total survey duration, and overall reported trip distance.

The descriptive analysis of the data presented here is based on the 2,946 respondents who were included in the model estimation and is provided in four sections: screening and trip detail, stated preference, debrief and opinion, and demographic information questions.

Much of the analysis is divided into five market segmentations, peak-period ICC user trips, midday-period ICC user trips, night-period ICC user trips, weekend ICC user trips, and potential ICC user trips. The peak trip segment contains travelers who indicated their trip began on a weekday either during the AM Peak Period (6:00-9:00 AM) or in the PM Peak Period (4:00-7:00 PM). Midday trips began on a weekday between 9:00 AM and 4:00 PM. Night trips began on a weekday between 7:00 PM and 6:00 AM.

3.3.1 Screening and Trip Detail

Of the 2,946 reported trips in the survey sample, 92.7 percent used the ICC (ICC users) and 7.3 percent of trips used a competing route but could have reasonably used the ICC (potential ICC users). Respondents who used the ICC indicated many reasons for doing so, including time savings (indicated by 80 percent of ICC users), less congestion (75 percent), convenience (57 percent), and more reliable travel time (53 percent).

3.3.1.1 Trip Purpose

Respondents were asked about the purpose of their most recent trip in the study area. There were slight differences in trip purpose by user type as shown in **Figure 3-4**. Overall, non-work-related trips were reported more frequently than work trips. In addition to the high incidence of social and recreational trips, this implies that the corridor is commonly used for infrequent travel. However, combining work trips and work-related business trips accounted for 36 percent of the respondents, thus indicating the ICC supports a broad mixture of trip purposes throughout the week. Work and non-work trip are broken down in more detail in **Table 3-2**.

3.3.1.2 Trip Distance and Travel Time

The latitude and longitude coordinates for each trip's origin-destination pair were used to calculate the trip distance and expected trip travel times. ICC users and potential ICC users had the same median trip distance of 24 miles, but median reported travel time was five minutes shorter for ICC users (45 minutes) than potential ICC users (50 minutes).

Trip origins and destinations, stratified by distance, are displayed in **Figure 3-5** and **Figure 3-6**, respectively. Trip origins are shown to be spread throughout the study corridor, with many trips greater than 30 miles clustered around the western portion of the ICC corridor. A handful of trips greater than 30 miles also originated in and around Baltimore, MD. Trip destinations are slightly more dispersed then trip origins, with many trips between 16–30 miles and greater than 30 miles ending northeast and southeast of the ICC corridor and in and around Baltimore.

Respondents were asked about their perceived travel-time delay or savings, depending on whether they were an ICC user or potential ICC user, respectively. Thirty percent of the 215 potential ICC users reported experiencing delay due to traffic congestion during their trip. ICC users were asked to estimate how much time the ICC saved them on their trip. A total of 14 percent of ICC users indicated that they believed traveling on the ICC saved them less than 10 minutes, while 33 percent reported between 10 and 19 minutes, 25 percent reported between 20 and 29 minutes, and 28 percent indicated they thought the ICC saved them 30 or more minutes of travel time on their trip.

Figure 3-4
Primary Trip Purpose by User Type

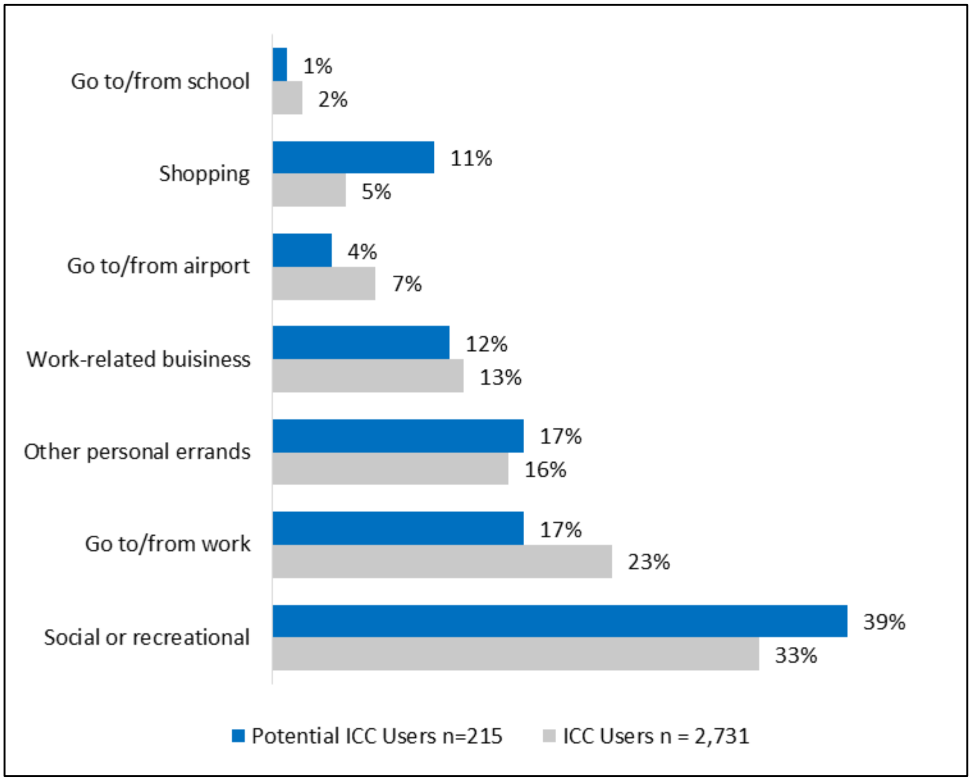


Table 3-2
Work and Non-Work Trips by Segment

	Trip Type					
Segment	Work Count	Percent of Trips	Non-work Count	Percent of Trips	**Total Count**	**Percent of Trips**
ICC User Peak	600	63.2	350	36.8	**950**	**100.0**
ICC User Midday	260	33.3	521	66.7	**781**	**100.0**
ICC User Night	65	34.6	123	65.4	**188**	**100.0**
ICC User Weekend	60	7.4	752	92.6	**812**	**100.0**
Potential ICC User	61	28.4	154	71.6	**215**	**100.0**
Total	**1,046**	**35.5**	**1,900**	**64.5**	**2,946**	**100.0**

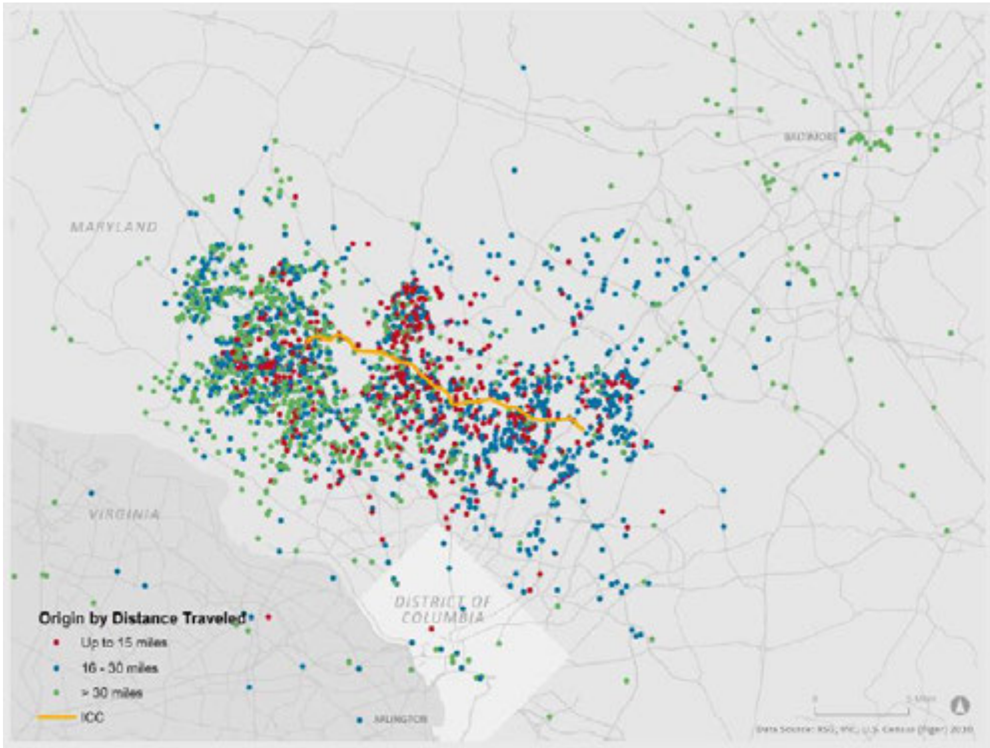


Figure 3-5
Trip Origins by Trip Distance

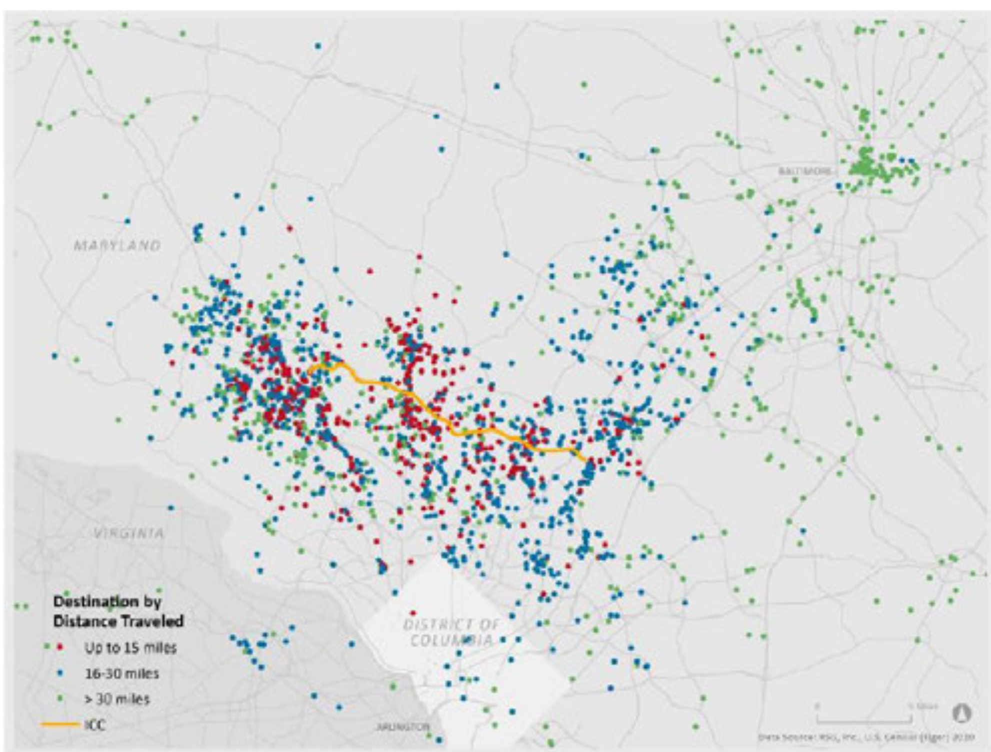


Figure 3-6
Trip Destinations by Trip Distance

3.3.1.3 Other Results

Reported vehicle occupancy is shown in **Figure 3-7** by work and non-work trip purposes. Of work trips, 88 percent were made in a single occupancy vehicle (SOV), while only 42 percent of non-work trips were made in a SOV. For all reported trips, the mean occupancy was 1.59 passengers.

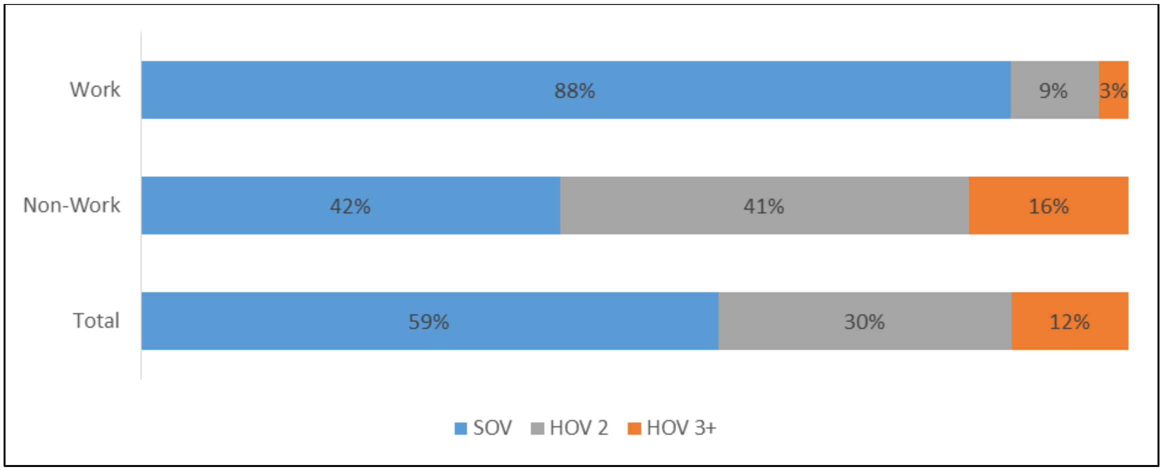


Figure 3-7
Vehicle Occupancy

Trip frequency, or the number of times per week a respondent makes the same reference trip between the same locations and in the same direction, is shown in **Figure 3-8**. As would be expected, work trips (which includes work commute and business related travel) were made more frequently than non-work trips. Of the 1,046 work trips, 38 percent of respondents indicated they made their reference trip four or more times per week, and 27 percent indicated they made their reference trip one to three times per week. For non-work trips, 82 percent of respondents indicated they made their trip less than one time per week and 18 percent indicated they made their trip more than once per week. The average trip frequency for all respondents was 1.3 trips per week.

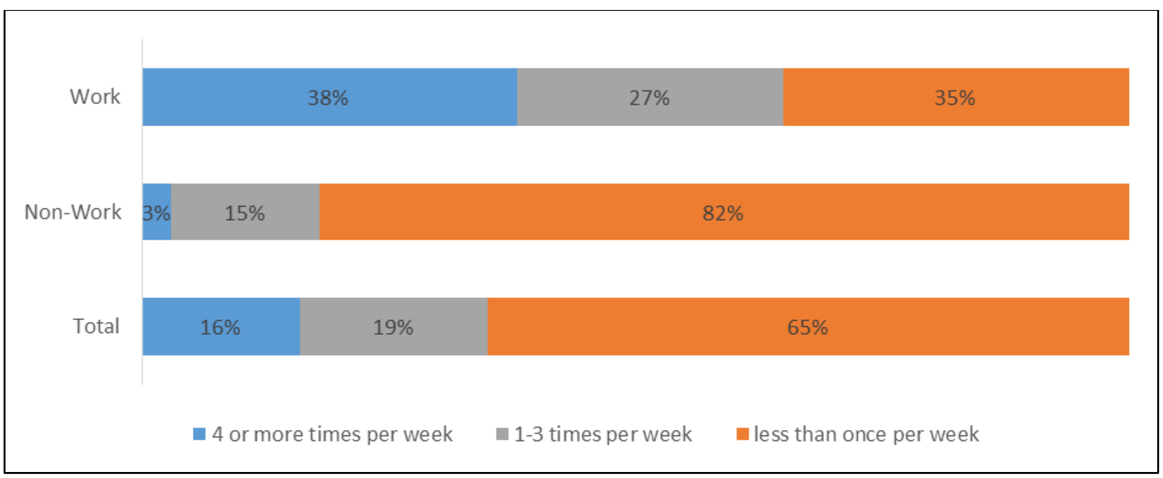


Figure 3-8
Trip Frequency

Respondents recruited by a method other than through their E-ZPass® account were asked to indicate whether they owned an E-ZPass® or another type of transponder. Of the 608 respondents, 71 percent had an E-Z Pass® device in their vehicle. Only 16 percent of ICC users indicated they did not own a transponder, compared with 73 percent of potential ICC users.

3.3.2 Stated Preference Scenarios

Out of the 29,460 total choice experiments administered in the survey, respondents in this study chose the ICC in 42 percent of experiments, the toll-free route in 54 percent of experiments, and the ICC at a different time of day in 14 percent of the experiments. Analysis of the stated preference data is described in more detail later in this chapter.

3.3.3 Debrief and Opinion Questions

After completing the stated preference scenarios, respondents were asked to answer a series of debrief questions to understand the underlying reasons for their choices during the hypothetical trade-offs. The opinion questions and attitude statements were included to help identify those respondents in the sample who may have responded to the stated preference scenarios in a strategic fashion that did not necessarily reflect how they would have actually behaved.

Respondents who never chose to use the ICC to make their trip in the previous section were asked to select the reason that best describes their choice. Of the 2,946 respondents, 223 never selected the tolled alternative. The most commonly selected reason, chosen by 37 percent of respondents, was "time savings were not worth the toll cost." Other frequently cited reasons were "tolls are too high" (29 percent) and "opposed to paying tolls" (17 percent).

Additionally, respondents presented with the option to travel earlier or later than their reported departure time, and who never selected to change the time of their trip, were asked to indicate the primary reason for their choice. The most commonly selected reason, "I prefer my current departure time," was selected by 32 percent of respondents. Another frequently cited reason, selected by 29 percent of respondents, was "time required to shift current trip is too great."

Potential ICC users were asked to indicate what would make them more likely to use the ICC for some of their trips in the future. Respondents were able to select multiple responses. Of the 215 respondents who did not use the ICC on their reported trip, the following indicated they would be more likely to use the ICC on some of their trips if:

- 171 (80 percent) would if there were lower toll costs;
- 79 (37 percent) would if there were larger off-peak and weekend discounts;
- 59 (27 percent) would if there was a higher speed limit;
- 38 (18 percent) would for other reasons; and
- 22 (10 percent) would if there were more on/off ramps.

All respondents were presented with the series of questions regarding their attitudes concerning tolls (shown previously in this chapter) and were asked to indicate the level to which they agreed or disagreed with the statements. The results were differentiated by ICC users and potential ICC users. A total of 96 percent of ICC users agreed with the statement, "I will use a toll route if the tolls are reasonable and I will save time." Of the four toll attitude statements presented, ICC users disagreed at the highest rate (28 percent) with the statement, “I support increased or new taxes to pay for highway improvements that relieve congestion.” Overall, this statement solicited a mixed response, with 48 percent agreeing and 24 percent indicating a neutral opinion. Potential ICC users tended to disagree more with the statements about using or supporting tolls as compared to ICC users.

3.3.4 Demographic Questions

Respondents were asked a series of demographic questions at the survey’s conclusion. A total of 60 percent of survey respondents identified as male and 40 percent identified as female. The median age of the sample fell in the 45 to 54 year-old category. Forty-two percent of respondents indicated they live in a two-person household and half of respondents stated they live in a household with two vehicles. A majority of respondents (64 percent) were employed full-time, 17 percent were retired, and 9 percent were self-employed. The median household income of respondents who chose to report their income fell in the $125,000 to $149,000 category. Responses regarding annual household income, segmented by ICC users and potential ICC users, are shown in **Figure 3-9**.

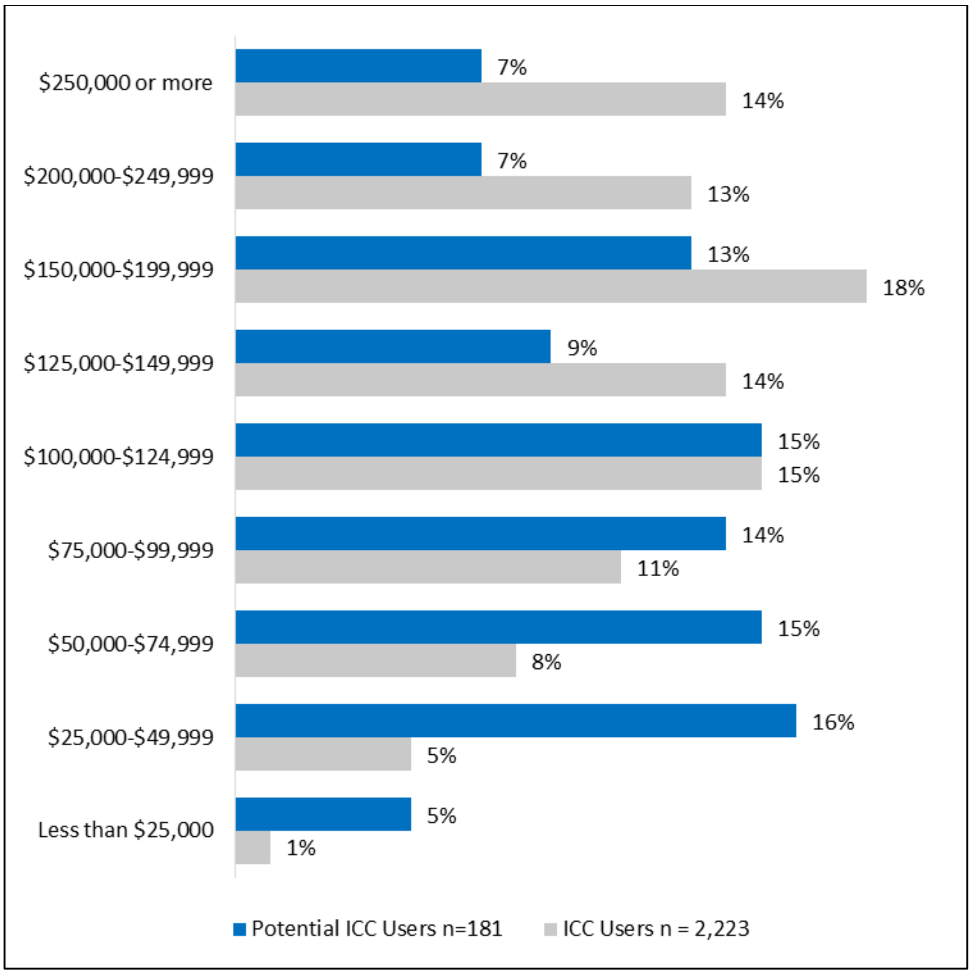


Figure 3-9
Annual Household Income by User Type

3.4 Model Estimation

The primary objective of the stated preference survey was to estimate the VOT for passenger car travelers who make trips in the ICC corridor. The 10 choice observations for each respondent were compiled into a dataset with 29,460 observations to support the estimation of VOT.

Statistical analysis and discrete choice model estimation were conducted using the survey data. The statistical estimation and specification testing were completed using a conventional maximum likelihood procedure that estimated coefficients for a set of multinomial logit (MNL) models. The model coefficients provide information about the respondents' sensitivities to the attributes that were used in the trade-off scenarios presented in the stated preference experiments. These sensitivities are ultimately expressed as the value of time savings for travelers in the study area and served as inputs into the travel demand model to forecast behavioral response, traffic, and toll revenue for the ICC.

One way to evaluate the sensitivities that are estimated in the MNL models is to calculate the marginal rates of substitution for different attributes of interest. In basic economic theory, the marginal rate of substitution is the amount of one good (e.g., money) that a person would exchange for a second good (e.g., travel time), while maintaining the same level of utility, or satisfaction. In this analysis, the marginal rate of substitution of the travel time and toll cost coefficients provides the implied toll value that travelers would be willing to pay for a given travel time savings offered on the ICC compared to a toll-free route. The willingness to pay for travel time savings, or VOT, can be calculated by dividing the travel time coefficient by the toll cost coefficient after accounting for the income transformation that was applied in the model specification. A more detailed overview of the MNL analysis can be found in **Appendix A**.

In summary of the results, the magnitude and signs of the sensitivity estimates were found to be reasonable and intuitively correct, and the VOT that were estimated are within the ranges found in other similar areas across the country. For ICC users, average VOT across different income groups for the segments generally fell within a range of $8.00 per hour to $16.00 per hour. For potential ICC users, average VOT across different income groups varied from $6.00 per hour to $10.00 per hour. The survey and choice model results indicate that the toll amount and travel time savings provided by the ICC corridor could have a significant impact on travel behavior. The values of time evaluated at each income category midpoint by each of the ten market segments are shown in **Table 3-3.**

Table 3-3
Value of Time by Market Segment and Income

Household Income	ICC Users								Potential ICC Users	
	Peak Work	Peak Non-work	Midday Work	Midday Non-work	Night Work	Night Non-work	Weekend Work	Weekend Non-Work	Work	Non-work
$12,500	$9.15	$9.90	$9.97	$9.92	$8.09	$9.18	$8.65	$9.86	$5.83	$6.21
$37,500	$11.23	$12.16	$12.24	$12.17	$9.93	$11.27	$10.61	$12.10	$7.16	$7.62
$62,500	$12.19	$13.21	$13.29	$13.22	$10.79	$12.24	$11.53	$13.14	$7.77	$8.28
$87,500	$12.83	$13.90	$13.99	$13.91	$11.35	$12.88	$12.13	$13.83	$8.18	$8.71
$112,500	$13.31	$14.41	$14.51	$14.43	$11.78	$13.36	$12.58	$14.34	$8.48	$9.03
$137,500	$13.69	$14.82	$14.92	$14.84	$12.11	$13.74	$12.94	$14.75	$8.73	$9.29
$175,000	$14.14	$15.32	$15.42	$15.34	$12.52	$14.20	$13.37	$15.24	$9.02	$9.60
$225,000	$14.62	$15.83	$15.94	$15.85	$12.94	$14.68	$13.82	$15.76	$9.32	$9.92
$250,000	$14.82	$16.05	$16.16	$16.07	$13.11	$14.88	$14.01	$15.97	$9.45	$10.06

3.5 Conclusions

A Stated Preference (SP) survey was developed and implemented that gathered information from 2,946 passenger car travelers who made trips in the ICC / MD 200 corridor in Maryland. The questionnaire collected data on current travel behavior, presented respondents with information about the ICC / MD 200 corridor, and engaged the travelers in a series of SP scenarios.

Survey respondents represented a wide range of different trip purposes, household incomes, travel times, and geographies. A total of 60 percent of survey respondents identified as male and 40 percent identified as female, with the median age of the sample falling in the 45 to 54 year-old range. The median household income of respondents who chose to report their income fell in the $125,000 to $149,000 range.

Overall, non-work-related trips (64 percent) were reported more frequently than work trips (36 percent), which implies that the corridor is commonly used for infrequent travel but still supports a broad mixture of trip purposes throughout the week. ICC users and potential ICC users had the same median trip distance of 24 miles, but median reported travel time was five minutes shorter for ICC users (45 minutes) than potential ICC users (50 minutes). Trip origins are shown to be spread throughout the study corridor, with many trips greater than 30 miles clustered around the western portion of the ICC corridor. Trip destinations are slightly more dispersed then trip origins, with many trips between 16 and 30 miles and as well as trips greater than 30 miles ending northeast and southeast of the ICC corridor and in and around Baltimore, MD. For all reported trips, the mean vehicle occupancy was 1.59 passengers while the average trip frequency was 1.3 times per week.

Of the 215 respondents who did not use the ICC on their reported trip, 80 percent indicated they would be more likely to use the ICC on some of their trips if there were lower toll costs. Other things that would encourage non-ICC users to use the ICC included larger off-peak and weekend discounts, a higher speed limit, and more on/off ramps.

Although information on driver behavior and characteristics were collected as part of the survey, the primary purpose was to estimate the Value of Time (VOT) for passenger vehicle travelers in the region. This was done by using Multinomial Logit (MNL) choice models, which estimate VOT based on a series of individual toll versus alternative route choices made by survey respondents. A single model was developed that included separate time and cost coefficients for 10 market segments, based on time of day and trip purpose.

The magnitude and signs of the sensitivity estimates were considered reasonable and intuitively correct, and the VOT estimates that were developed were within the ranges found in other similar areas across the country. For ICC users, average VOT across different income groups for the market segments tested generally fell within a range of $8.00 per hour to $16.00 per hour. For potential ICC users, average VOT across different income groups varied from $6.00 per hour to $10.00 per hour. The survey and choice model results indicated that the toll amount and travel-time savings provided by the ICC/MD 200 corridor could have a significant impact on travel behavior. Ultimately, the VOT estimates were incorporated by CDM Smith into the project travel demand model that was used to forecast traffic and toll revenue for the ICC.

Chapter 4

Corridor Growth Assessment

Population and employment forecasts are a key input for developing trip generation estimates, the first step in building trip tables within the Metropolitan Washington Council of Governments (MWCOG) regional travel demand model, and ultimately demand for the ICC corridor. Reviewing projections as part of a corridor growth assessment for the ICC catchment area is thus an important step, particularly in the context of changing economic conditions in the past several years and, most recently, continued recovery from the Great Recession.

The first section of this chapter presents the need for a review of the historical ICC corridor and regional development. The methodology of applying adjustments to the MWCOG forecasts is discussed, followed by an overview of the projected growth trends. Finally, a summary of the main differences between the forecasts used for this study and the original MWCOG forecasts is presented.

4.1 Need for Review of MWCOG Socioeconomic Assumptions

This chapter presents an overview of geographically specific adjustments to the 2015 to 2040 employment, population, and household forecasts of the MWCOG regional travel demand model. The base forecasts used in this study were created by MWCOG in cooperation with its member jurisdictions and were released on October 15, 2014. This forecast, known as Round 8.3, projects population, employment and households for the 26 counties and independent cities representing the Washington, D.C., metropolitan area to 2040, in five-year increments. The forecast is broken out into 3,722 Traffic Analysis Zones (TAZs), with each zone containing only a few blocks of socioeconomically similar residential and/or commercial properties.

Standard practice in an investment-grade study is for the traffic and revenue consultant to retain an independent economist to review the socioeconomic forecasts of the regional planning agency, in this case MWCOG. This review is done for several reasons. First, the independent economist is able to make adjustments to the forecast that take into account recent economic developments not previously assumed within the regional planning agency dataset. Second, the socioeconomic forecasts developed by regional planning agencies are usually developed at a regional level. The independent economist is able to provide greater detail to forecasts, with a focus on the local study area. Lastly, a review from an independent economist provides a "second opinion" for rating agencies to consider as they assess the results of the traffic and revenue study supported by the socioeconomic forecasts.

Adjustments to the base MWCOG forecasts were made by Renaissance Planning Group (RPG), who provided independent economic growth projections throughout the Washington, D.C., metropolitan area as part of this study. RPG reviewed economic conditions and major development plans, focusing especially on those which could impact demand for the ICC. A separate report was prepared by RPG and is included in **Appendix B** of this report.

4.2 Geographical Context

Figure 4-1 shows the geographical context of the ICC facility relative to northeastern Virginia, eastern West Virginia, and central Maryland. Several important areas relative to this study are indicated. These include the MWCOG area, the Primary Jurisdictions, and the Primary Market Area. These are discussed in more detail below.

4.2.1 MWCOG Model Area

The MWCOG model area is inclusive of the areas colored in red, yellow, and green in **Figure 4-1**. As indicated previously, this area includes 26 counties and independent cities in the greater Washington, D.C., metropolitan area. It is bordered on the south and west by generally rural Virginia and West Virginia counties, on the east by Chesapeake Bay and Baltimore, Maryland, and on the north by Pennsylvania.

4.2.2 Primary Jurisdictions

The Primary Jurisdictions are the areas colored in yellow in **Figure 4-1** and also include some of the ICC Primary Market Areas colored in red. These include Anne Arundel, Frederick, Howard, Montgomery, and Prince George's Counties in Maryland as well as Washington, D.C. These six Primary Jurisdictions generate most of the traffic using the ICC on a daily basis. The socioeconomic forecasts presented and discussed in this chapter generally focus on the Primary Jurisdictions. This county (and Washington, D.C.) level of aggregation is useful to compare historical and forecasted growth trends.

4.2.3 ICC Primary Market Area

The smallest area colored in red in **Figure 4-1** is the Primary Market Area. The Primary Market Area is composed of model traffic analysis zones (TAZs) with the highest concentration of both origins and destinations using the ICC facility. Wherever possible, TAZs were selected to form a cohesive study area by avoiding holes and rough edges. Prior analyses have demonstrated that a reasonable Primary Market Area encompasses 85 percent of total facility origins and destinations. Beyond 85 percent the remaining users are generally too dispersed to be cohesive, as was the case in this study.

4.2.4 Relevant Jurisdictions External to MWCOG Model

The area colored in purple in **Figure 4-1** represents relevant jurisdictions external to the MWCOG Model, which includes the major traffic generators of Baltimore City and Baltimore County. This area, while outside the MWCOG model area, is included within the MWCOG model as a series of "external" TAZs. These areas are included within the MWCOG socioeconomic forecast dataset, including population, employment and other model factors. The forecasts for these areas were also reviewed by the independent economist. Moreover, CDM Smith provided additional detail to these TAZs by splitting the external zones as needed to replicate potential trip origins and paths. The trips from these external zones forecasted by the model were then reviewed in light of the traffic volumes on I-95, US 1 and other routes between Baltimore and the MWCOG model area.

The development patterns in the Washington, D.C., and Baltimore regions shape the ICC primary market area so that it encompasses a broader area to the north and east of the ICC (where development is more or less continuous between the Baltimore and Washington, D.C., beltways) and has a smaller geographic area at the western end of the ICC (where the Montgomery and Frederick County agricultural reserves limit trip generation of all types to a fairly narrow band along I-270).

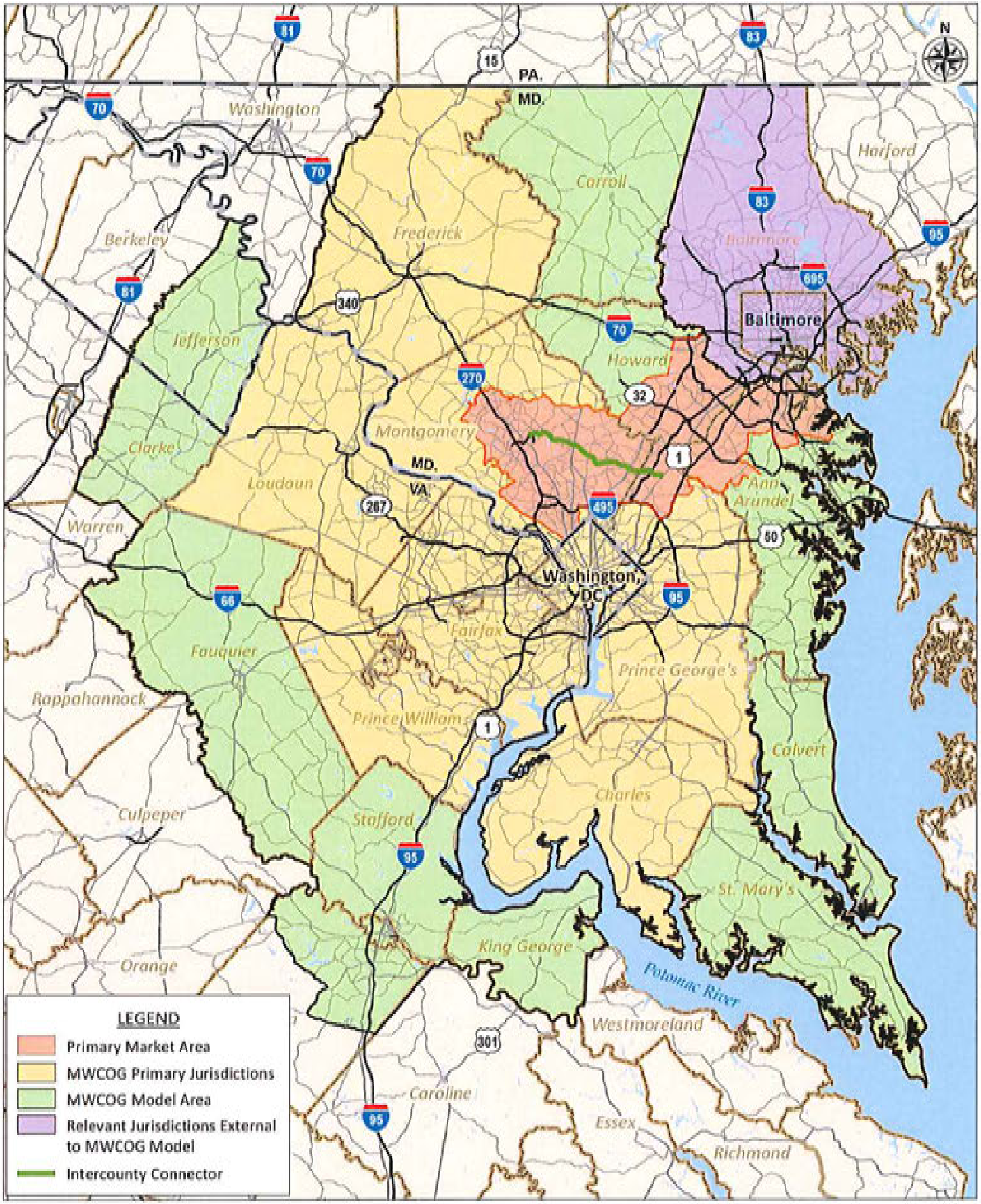


Figure 4-1
Intercounty Connector Geographic Context

4.3 Historic Trends

The following section presents a summary of historical economic and demographic trends. These trends were analyzed at multiple geographical levels in the course of making adjustments to the MWCOG projections.

Over the past 50 years, the Primary Jurisdictions have demonstrated the evolution of first-tier suburban growth typical of metropolitan areas along the eastern seaboard. In these metropolitan areas the central cities are landlocked and cannot expand through annexation, and have gone through a cycle of disinvestment and rebirth. In 1970, Washington, D.C., was the center of the regional economy, and had the largest residential population as well. Since then, as adjacent suburbs attracted both additional housing units and jobs growth, the inner-tier suburbs of Montgomery and Prince George's Counties surpassed Washington, D.C., in population (although not in population density) and Montgomery County's jobs total is approaching that of D.C. The next tier of suburbs (Anne Arundel, Howard, and Frederick Counties) are midway between Washington, D.C., and Baltimore, are still more oriented to bedroom communities than the first-tier suburbs, and send employed residents to both the Washington, D.C., and Baltimore employment cores.

Table 4-1 shows the historical population and employment growth trends in the Primary Jurisdictions. Maryland, Virginia, and U.S. trends are also provided for comparison. The suburbanization described previously can be seen in the population growth trends, for example with Montgomery County population surpassing Washington, D.C., between 1980 and 1990. The dispersal of employment in the region can also be seen. In 1970, Washington, D.C., included 52 percent of the total employment in the Primary Jurisdictions. Since then job growth has been much higher in the other five counties and the Washington, D.C., employment share had fallen to 32 percent in 2010.

The past 50 years have seen a large expansion in the geographic coverage of regional growth outward from the Capital Beltway. At the same time, increasing state and local growth controls are reinforcing the "wedges and corridors" type growth plans established in the 1960s. These plans call for development along urban corridors, along major roads and along transit lines while preserving adjacent land for agriculture and open space. A representative example is zoning regulations limiting development in Montgomery County's Agricultural Reserve. In light of this framework, continued population and housing growth is expected to occur more through redevelopment of underutilized sites than through greenfield developments constructed on farmland or forested land.

As population and employment growth occurred in the Primary Jurisdictions, there has been a notable shift in the level of wealth and economic status in D.C., as measured by the per capita income of its residents. This reflects both the importance of the federal government (and proximity to its main offices) in the regional economy and the recent trend of preference for urban living among the young, educated Millennial generation. Over the past 20 years, the District's per capita income moved from the middle of the pack among the Primary Jurisdictions to the highest of the group, surpassing the longtime leader Montgomery County since the end of the Great Recession. The income differences across the Primary Jurisdictions are quite distinct and have widened since 1990, as shown in **Figure 4-2**.

Table 4-1
Historical Population and Employment Growth Trends

Region Name	1970	1980	1990	2000	2010	AAPC [1] 1970 to 1980	AAPC [1] 1980 to 1990	AAPC [1] 1990 to 2000	AAPC [1] 2000 to 2010
Population									
Anne Arundel	298,042	370,775	427,239	489,656	537,656	2.2%	1.4%	1.4%	0.9%
Howard	62,394	118,572	187,328	247,842	287,085	6.6%	4.7%	2.8%	1.5%
Frederick	84,927	114,792	150,208	195,277	233,385	3.1%	2.7%	2.7%	1.8%
Montgomery	522,809	579,053	757,027	873,341	971,777	1.0%	2.7%	1.4%	1.1%
Prince George's	661,719	665,071	728,553	801,515	863,420	0.1%	0.9%	1.0%	0.7%
District of Columbia	756,510	638,333	606,900	572,059	601,723	-1.7%	-0.5%	-0.6%	0.5%
Total 5 Counties + DC	**2,386,401**	**2,486,596**	**2,857,255**	**3,179,690**	**3,495,046**	**0.4%**	**1.4%**	**1.1%**	**1.0%**
Maryland	**3,938,051**	**4,227,643**	**4,799,770**	**5,311,034**	**5,787,193**	**0.7%**	**1.3%**	**1.0%**	**0.9%**
Virginia	**4,659,930**	**5,368,334**	**6,216,884**	**7,105,817**	**8,024,417**	**1.4%**	**1.5%**	**1.3%**	**1.2%**
U.S.	**203,211,926**	**226,545,805**	**248,709,873**	**281,421,906**	**308,745,538**	**1.1%**	**0.9%**	**1.2%**	**0.9%**
Employment									
Anne Arundel	130,013	175,706	250,070	295,194	357,822	3.1%	3.6%	1.7%	1.9%
Howard	22,397	56,654	105,751	159,188	190,559	9.7%	6.4%	4.2%	1.8%
Frederick	33,439	44,042	72,323	103,859	129,184	2.8%	5.1%	3.7%	2.2%
Montgomery	235,394	349,504	512,644	592,976	647,652	4.0%	3.9%	1.5%	0.9%
Prince George's	198,903	264,059	372,367	391,158	424,306	2.9%	3.5%	0.5%	0.8%
District of Columbia	671,811	701,075	773,211	734,613	809,361	0.4%	1.0%	-0.5%	1.0%
Total 5 Counties + DC	**1,291,957**	**1,591,040**	**2,086,366**	**2,276,988**	**2,558,884**	**2.1%**	**2.7%**	**0.9%**	**1.2%**
Maryland	**1,702,298**	**2,070,441**	**2,737,249**	**3,087,534**	**3,344,652**	**2.0%**	**2.8%**	**1.2%**	**0.8%**
Virginia	**2,157,657**	**2,796,505**	**3,699,593**	**4,396,936**	**4,749,161**	**2.6%**	**2.8%**	**1.7%**	**0.8%**
U.S.	**91,277,600**	**113,983,200**	**138,330,900**	**165,370,800**	**173,044,700**	**2.2%**	**2.0%**	**1.8%**	**0.5%**

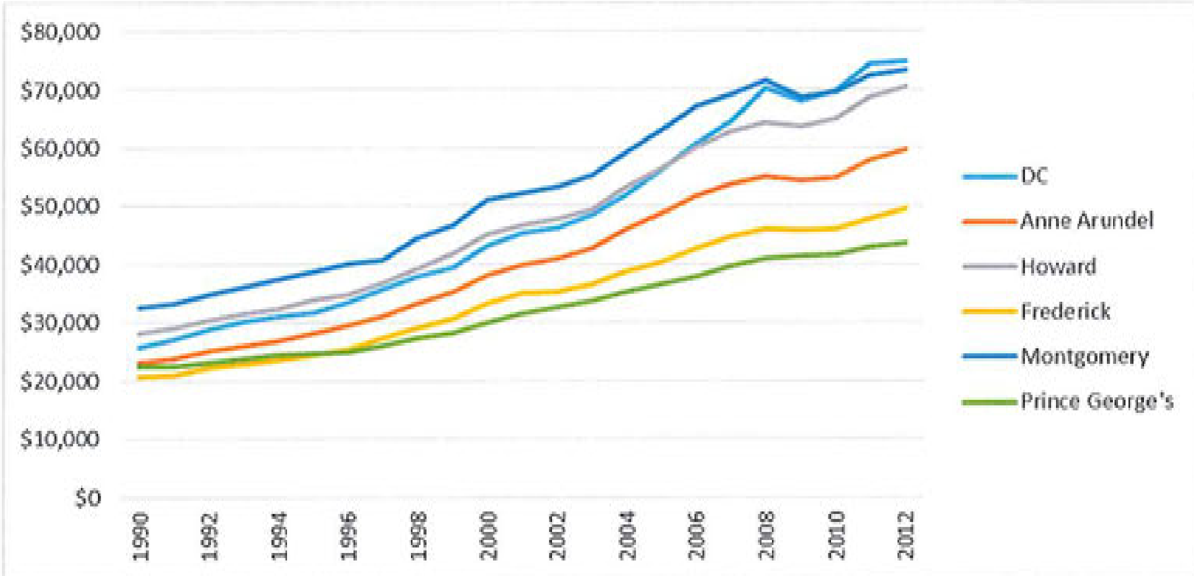


Figure 4-2
Per Capita Income Trends in the Primary Jurisdictions

4.4 Adjustment Methodology

Adjustments to the base MWCOG forecasts were made by RPG as part of this study. The RPG forecast adjustment methodology included top-down methods for analyzing population and employment totals, bottom-up methods for analyzing the supply of land, market-based macroeconomic information on the prospects for growth, and a forecasting tool integrating a variety of predicting variables that was used to analyze and apply adjustments at the TAZ level. The overall approach included the following steps:

- Interagency and intergovernmental coordination with Annie Arundel County, Howard County, Montgomery County Planning Department, and Prince George's County Planning Department to obtain their perspectives on base MWCOG forecasts;
- Macroeconomic assessment of past trends, present conditions and near-term future prospects for residential development and absorption as well as job creation within the Washington, D.C., metropolitan area;
- Establishment of a 2014 baseline condition;
- Initial forecasts for 2020 through 2040 based on macroeconomic factors of population and employment to be used as guidance in preparing the final adjusted forecast;
- Detailed "Gridcell" evaluation of existing conditions and land supply side factors for the Primary Market Area; and
- Modeling and testing the validity of MWCOG forecasts at the TAZ level for the District of Columbia and Anne Arundel, Frederick, Howard, Montgomery and Prince George's Counties.

Several of the steps listed above are discussed in more detail in the sections below.

4.4.1 Macroeconomic Assessment

Through the Great Recession of 2007-2009 the Washington, D.C., metropolitan area was arguably the strongest regional economy and real estate market in the U.S., thanks to its reliance on federal employment and contracting that was much less affected by the financial crisis than other industries. However, in subsequent years the metropolitan economy has weakened somewhat due to federal cutbacks, many mandated or influenced by sequestration. A general overview of the regional economy that was used as a framework for this analysis is provided below. This overview is based on a recent presentation by Steven Fuller from George Mason University[1]:

- In general, the region made it through federal sequestration with less pain than anticipated. There are still strengths in the economy and its demographics, especially high education and income levels.
- To some extent the stronger regional economic performance during the Great Recession, while most of the rest of the U.S. was hurting, has left little room to improve.
- Only three sectors posted GRP increases from 2012-2013: food service/hotels/entertainment, education/health services, and retail. These are all primarily local-serving sectors driven by population growth.
- Federal spending is still tight and federal employment is still decreasing. However, the region's economy is starting to pick up, after trailing the rest of the U.S., as the national economy has strengthened.

The remainder of this section presents a summary of additional demographic, economic, and real estate trends taking place that are likely to influence the course of development in and around the Primary Market Area.

4.4.1.1 Federal Employment

As highlighted previously, federal employment is a main driver of many of the recent trends in the metropolitan area economy. For context, about 14 percent of the total Primary Jurisdiction area employment has been federal employment in recent years. **Figure 4-3** shows the recent trend in federal employment broken down by several areas in the region. The impact of federal cutbacks described previously can be seen in this graph, especially in the key federal employment center of Washington, D.C.

4.4.1.2 Washington, D.C., Housing and Population

From April 2010 to July 2012 Washington, D.C., added more population than it did from 2000-2010. Over half of these people were aged 25 to 34 and included in the Millennial generation. These trends have been well documented in many media reports, especially related to revitalization of many urban core neighborhoods. However, close observers have expressed concern relating to how long this trend can last. One challenge to continued growth is housing costs which have spiked along with the population. For example, a study by the U.S. Bureau of Labor Statistics found that the Washington, D.C.

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[1] "The U.S. and Washington Area Economic Performance and Outlook." Stephen S. Fuller, Ph.D. Center for Regional Analysis, George Mason University. April 23, 2015.
http://cra.gmu.edu/pdfs/studies_reports_presentations/Washington_Building_Congress_042315.pdf

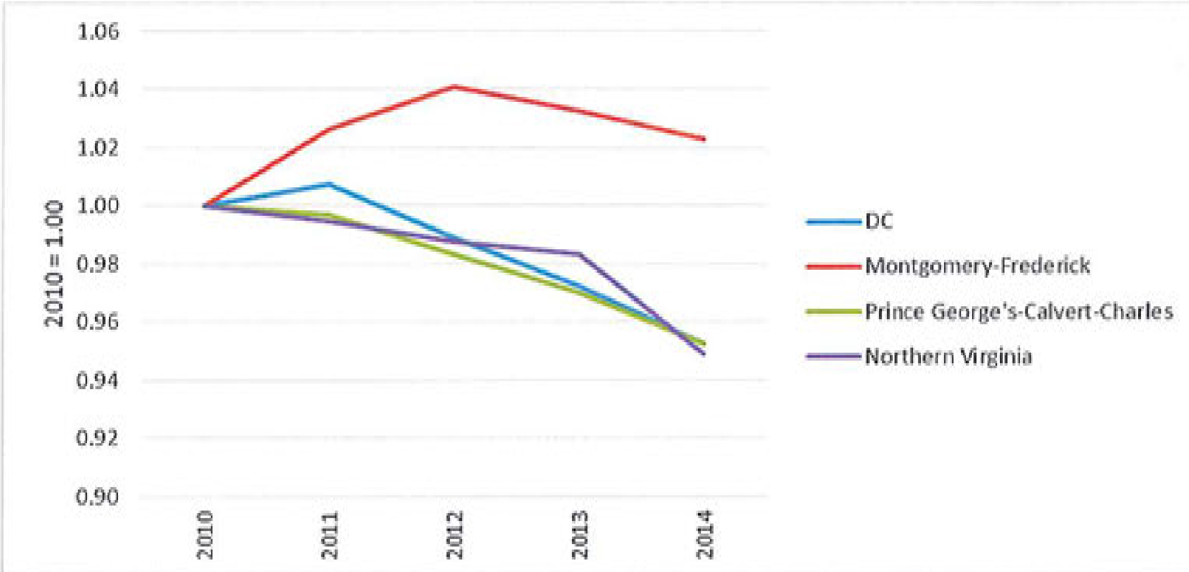

Figure 4-3
Federal Employment Trends Since 2010

metropolitan area had the highest average annual housing costs in U.S. for 2011-2012. Continuing in-migration of young urban professionals to the urban core is expected over the next several decades. However, cost of living concerns and the tendency for aging and growing Millennial families to leave the Washington, D.C., urban core (as indicated in other research) suggests that the population growth estimates for Washington, D.C., in the base MWCOG Round 8.3 forecasts are somewhat optimistic.

4.4.1.3 Suburban Growth Relative to Urban Center

Many varying factors are driving suburban growth prospects in the Washington, D.C., metropolitan area. Several of these are discussed below.

First, the trend of Millennials moving into urban core neighborhoods is real and significant, but this represents a relatively small share of the total Millennial population. Most Millennials are living in the suburbs, particularly the older suburbs just outside the central city. Numerous surveys have also found that many Millennials still aspire to own a home and live in the suburbs eventually.

Studies also indicate the closer-in, transit-served employment centers will maintain their strong market positions, and perhaps even strengthen as the Millennial generation ages, increases its earning power, and continues to assert its influence in the marketplace. In addition, it appears that walkability is increasingly driving the commercial real estate market in the Washington, D.C., region, and most of the walkable places are in or near the urban core or along Metrorail lines.

Even though companies moving downtown have been getting most of the attention, suburban office markets that were hit hard by the recession are starting to come back. However, recovery is typified by a focus on the best locations, so many secondary and lower-tier suburban markets are still struggling or stagnant. For example, the suburban Maryland office market seems to be representative of this, with development and absorption activity mostly confined to Bethesda and Rockville.

The overarching trend in population growth appears to be divided, with the strongest growth in the truly urban neighborhoods near the urban center and in selected farther out suburbs. One analyst concludes: "So are suburban areas growing faster than urban areas? The simple answer is yes. But the fuller answer is that some urban neighborhoods are growing fast and some suburban neighborhoods even faster. The best evidence of urban growth is in the densest city neighborhoods, not in a shift within suburbia toward more urban suburbs. Growth is currently favoring the densest urban neighborhoods and the most suburban suburbs, not the neighborhoods in between."[2]

4.4.2 2014 Baseline

The assessment of 2014 conditions was based on a pivot from the MWCOG Round 8.3 estimates for 2015, the 2013 and 2014 estimates for jurisdiction-level population developed by the U.S. Census Bureau, the American Community Survey (ACS) estimates for 2008-2013, and information on the status of substantial commercial property development.

The 2014 county-level population estimates released by the Census Bureau in March 2015 revealed that the Primary Jurisdictions in the ICC study area all had population estimates that approached or exceeded the base MWCOG Round 8.3 estimates for 2015. Based on available information, the Round 8.3 2015 population estimates were adopted as representative for 2014 for TAZs in the Primary Market Area and some additional adjustments were made outside the Primary Market Area to reflect the trends in the 2014 population estimates. Note that neither the ACS estimates for 2013 or 2014 were adopted outright, both due to the fact that sub-jurisdictional forecasts are not made available and the fact that the estimates are, in fact, also only estimates of population and are occasionally found lacking when compared to the decennial census. For instance, in 2010, the decennial census found the City of Alexandria's population to be 139,966, whereas the 2009 ACS estimate of the population was 150,006.

Regarding employment, specific adjustments were made to several TAZs where notable milestone projects were either behind or ahead of schedule. Linear interpolation between 2010 and 2015 was then performed to estimate the remaining 2014 employment levels.

4.4.3 Preliminary Macroeconomic Forecasts

The 2020, 2025, 2030, and 2040 base MWCOG Round 8.3 population and employment forecasts were compared to long-term forecasts obtained from different sources. For population and employment, comparison forecasts were obtained from the Maryland state government department (dated March 2014 for employment and July 2014 for population), Washington, D.C., government (from the Weldon Cooper Report, August 2013 for population only), Woods & Poole Economics (2014), and Moody's Analytics (August 2014). Comparisons were made for each of the five counties and Washington, D.C., that comprise the Primary Jurisdictions.

Figure 4-4 and **Figure 4-5** show growth comparisons at the total Primary Jurisdiction level. A "RPG Initial" forecast is also provided that shows the results of initial high-level adjustments made by RPG to the base MWCOG Primary Jurisdiction population and employment forecasts. These initial high-level MWCOG forecast adjustments were based on review of the comparison forecasts, discussions in the interagency and intergovernmental coordination meetings, and the macroeconomic assessment described previously. Further adjustments to these high-level forecasts were made based on detailed

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[2] Kolko, Jed. "No, Suburbs Aren't All the Same. The Suburbiest Ones Are Growing Fastest." CityLab. February 5, 2015. http://www.citylab.com/housing/2015/02/no-suburbs-arent-all-the-same-the-suburbiest-ones-are-growing-fastest/385183

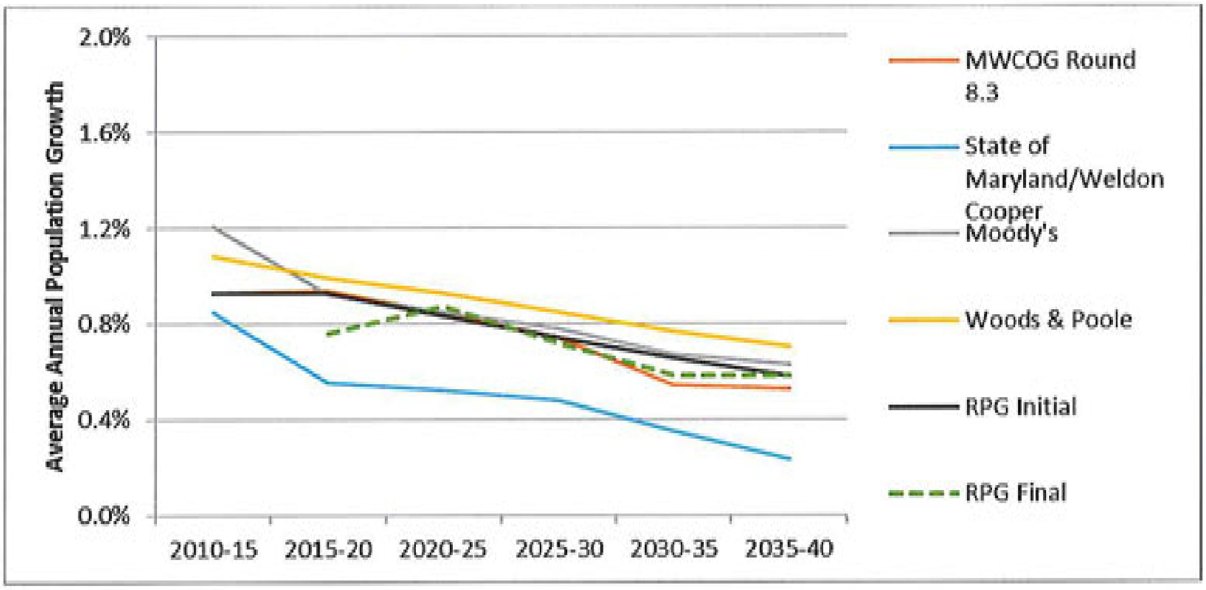


Figure 4-4
Comparison of Forecasts for Total Population Growth in Six Primary Jurisdictions

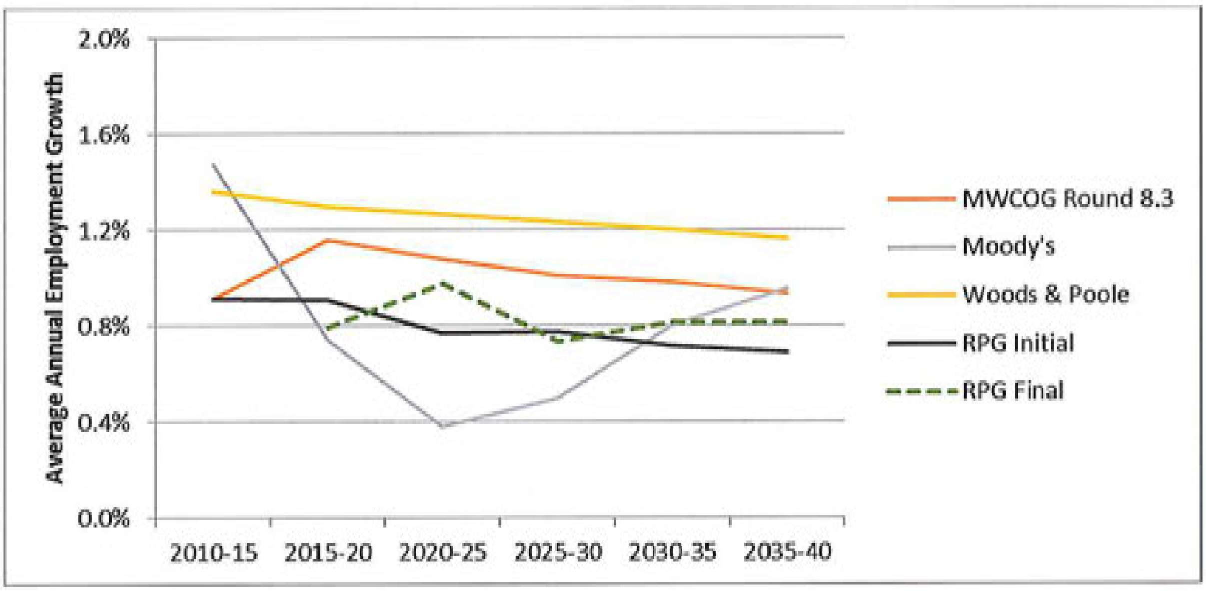


Figure 4-5
Comparison of Forecasts for Total Employment Growth in Six Primary Jurisdictions

analysis of local characteristics as described in the following sections of this chapter. The "RPG Final" forecast shown includes all further adjustments to the "RPG Initial" forecasts. Note that employment forecasts need to be compared in terms of average annual growth, shown here rather than absolute numbers, to account for differing definitions of "employment" across different sources. The differing employment definitions are discussed in more detail later in this chapter.

Regarding the RPG Initial forecasts, population projections are slightly higher overall and employment projections are lower compared to the base MWCOG Round 8.3 forecasts. More specific reasons for these adjustments are discussed in more detail later in this chapter with the final forecasts.

4.4.4 Gridcell Level Analysis

An analysis of land use in the Primary Market Area was conducted to understand the existing conditions for residential and non-residential development and availability of developable land by TAZ. The Primary Market Area was divided into one-acre gridcells for this analysis. An iterative regression analysis process was applied to each gridcell that combined quantitative land use data with a separate variable representing various qualitative elements that enter into the actual land development process.

A number of the quantitative factors were found to be useful predictors of growth in the region. For example, the presence of roads and streets with pedestrian and bicycle accommodations had a positive effect on forecast jobs and housing growth. These streets are prevalent in areas that have a robust street grid to accommodate infill development. The development and analysis of these type of predictive variables provides a sense of environments most likely to be associated with MWCOG growth forecasts and provides the ability to identify outliers. In some cases, these outliers may reflect other known, site-specific influences on development attractiveness. In other cases they may indicate areas where adjustments to the forecasts are warranted.

4.5 MWCOG Adjusted Forecasts

This section provides the final adjusted forecasts used in this study. The final forecasts were based on a combination of the top-down macroeconomic approach and bottom-up gridcell analysis described previously as well as a final step to test the validity of MWCOG forecasts at the TAZ level for the Primary Jurisdictions. This final step combined a systematic application of independent variables with site-specific knowledge to derive a TAZ-specific forecast that pivots from the base MWCOG Round 8.3 forecasts. The following overarching trends are included in the final adjusted forecasts:

- Among the six Primary Jurisdictions, Montgomery County is best positioned to attract both residential and commercial growth. Montgomery County also has the largest geographic and demographic share of the ICC Primary Market Area.
- The final forecasts predict a lower number of jobs in the Primary Jurisdictions. A total of 142,000 fewer jobs in 2040 are predicted, with a steady decline from the Round 8.3 forecasts out to 2040.
- The final forecasts indicate a higher number of residents in the primary jurisdictions (44,000 more residents by 2040), with the notable exception being Washington, D.C. Considering D.C., a continued increase in population is predicted, but slowed notably from the rates projected in the base MWCOG Round 8.3 forecasts. Conversely, Montgomery County is predicted to be best positioned to experience the greatest residential growth based on location, market forces, and planning initiatives.

4.5.1 Final Forecasts

The final population and employment forecasts, as well as the corresponding growth rates, are shown in **Table 4-2** below. The maps in **Figure 4-6** and **Figure 4-7** show the average annual population growth for the Primary Market Area TAZ's for 2014 to 2020 and 2020 to 2040, respectively. **Figure 4-8** and **Figure 4-9** show the same maps for employment.

Table 4-2
Final Population and Employment Forecasts

Region Name	2014	2015	2020	2025	2030	2040	AAPC [1] 2014 to 2015	AAPC [1] 2015 to 2020	AAPC [1] 2020 to 2025	AAPC [1] 2025 to 2030	AAPC [1] 2030 to 2040
Population (thousands)											
Anne Arundel	558	561	578	595	610	636	0.6%	0.6%	0.6%	0.5%	0.4%
Howard	301	305	325	346	357	368	1.3%	1.3%	1.3%	0.6%	0.3%
Frederick	242	245	259	279	298	330	1.2%	1.1%	1.5%	1.3%	1.0%
Montgomery	1,021	1,030	1,071	1,126	1,181	1,272	0.8%	0.8%	1.0%	1.0%	0.7%
Prince George's	901	904	919	943	965	1,002	0.3%	0.3%	0.5%	0.5%	0.4%
District of Columbia	661	668	704	738	762	813	1.1%	1.1%	0.9%	0.6%	0.7%
Total 5 Counties + DC	**3,683**	**3,712**	**3,855**	**4,026**	**4,173**	**4,422**	**0.8%**	**0.8%**	**0.9%**	**0.7%**	**0.6%**
Employment (thousands)											
Anne Arundel	318	321	335	348	355	391	0.9%	0.9%	0.8%	0.4%	1.0%
Howard	170	172	182	191	199	209	1.1%	1.1%	1.0%	0.9%	0.5%
Frederick	101	102	106	109	114	124	0.8%	0.8%	0.6%	0.8%	0.9%
Montgomery	530	534	553	595	625	701	0.7%	0.7%	1.5%	1.0%	1.2%
Prince George's	354	357	371	379	393	426	0.8%	0.8%	0.4%	0.7%	0.8%
District of Columbia	809	815	847	890	921	975	0.8%	0.8%	1.0%	0.7%	0.6%
Total 5 Counties + DC	**2,283**	**2,301**	**2,394**	**2,513**	**2,607**	**2,826**	**0.8%**	**0.8%**	**1.0%**	**0.7%**	**0.8%**

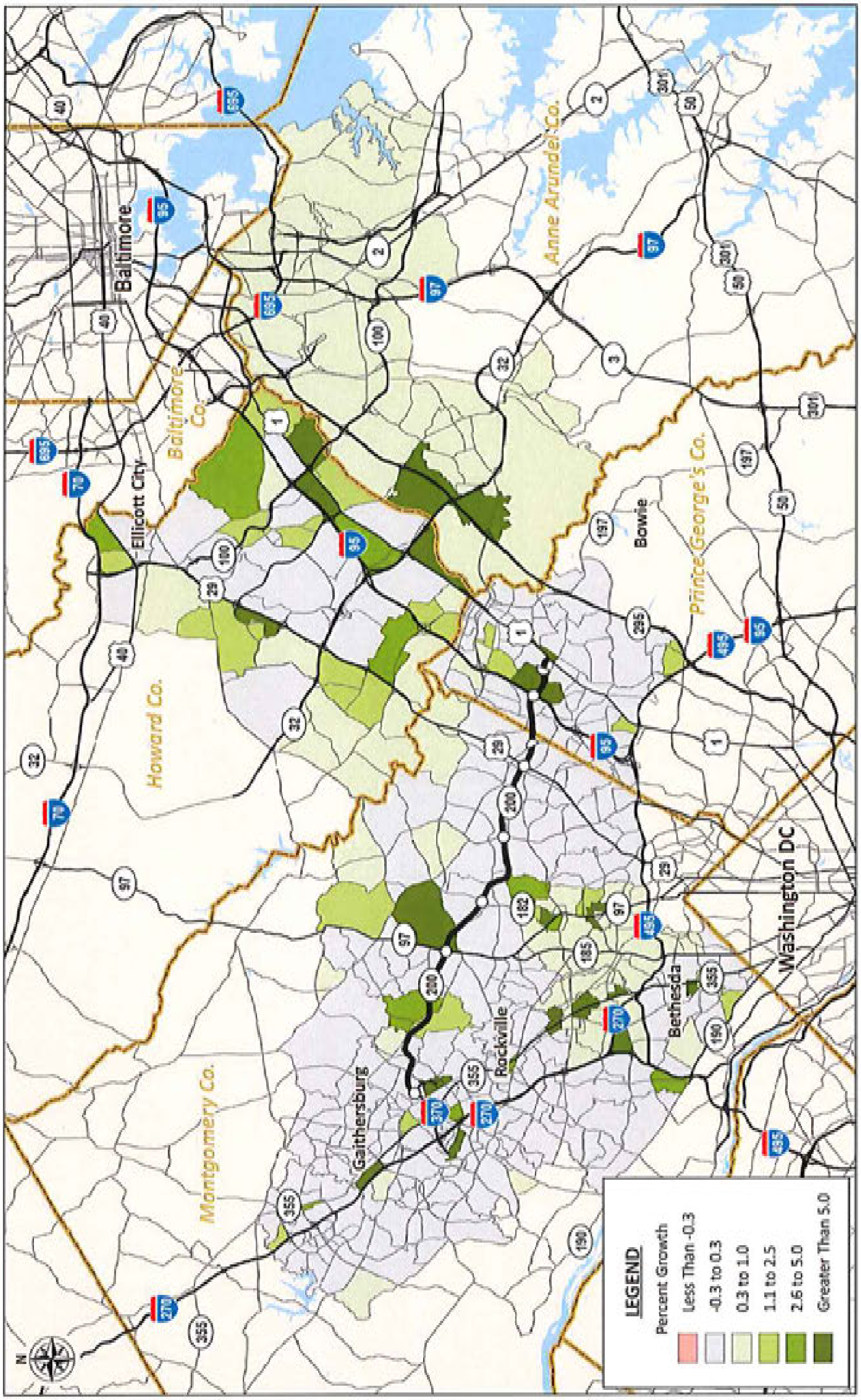


Figure 4-6
Average Annual Population Growth by TAZ
2014 - 2020

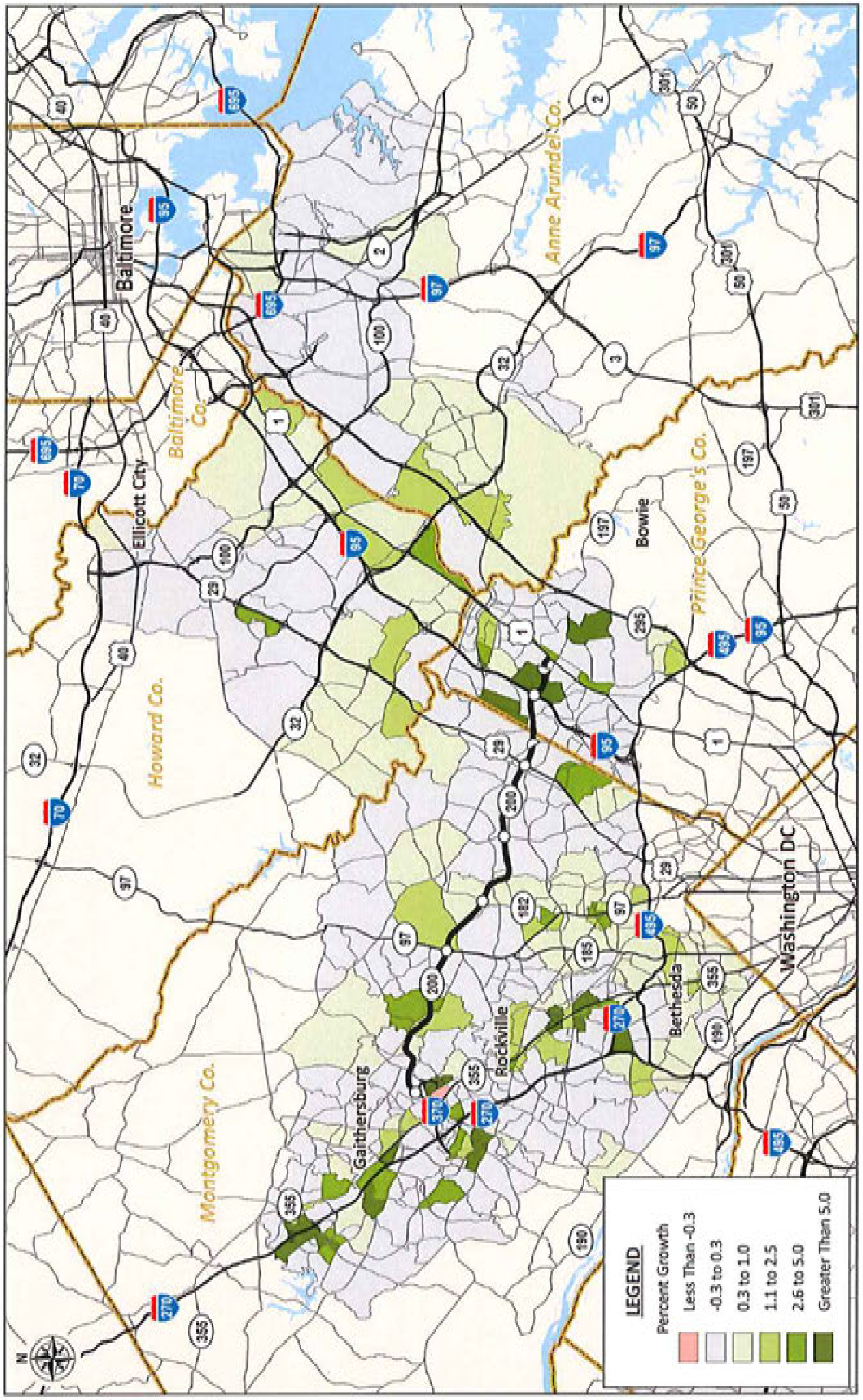


Figure 4-7
Average Annual Population Growth by TAZ
2020 - 2040

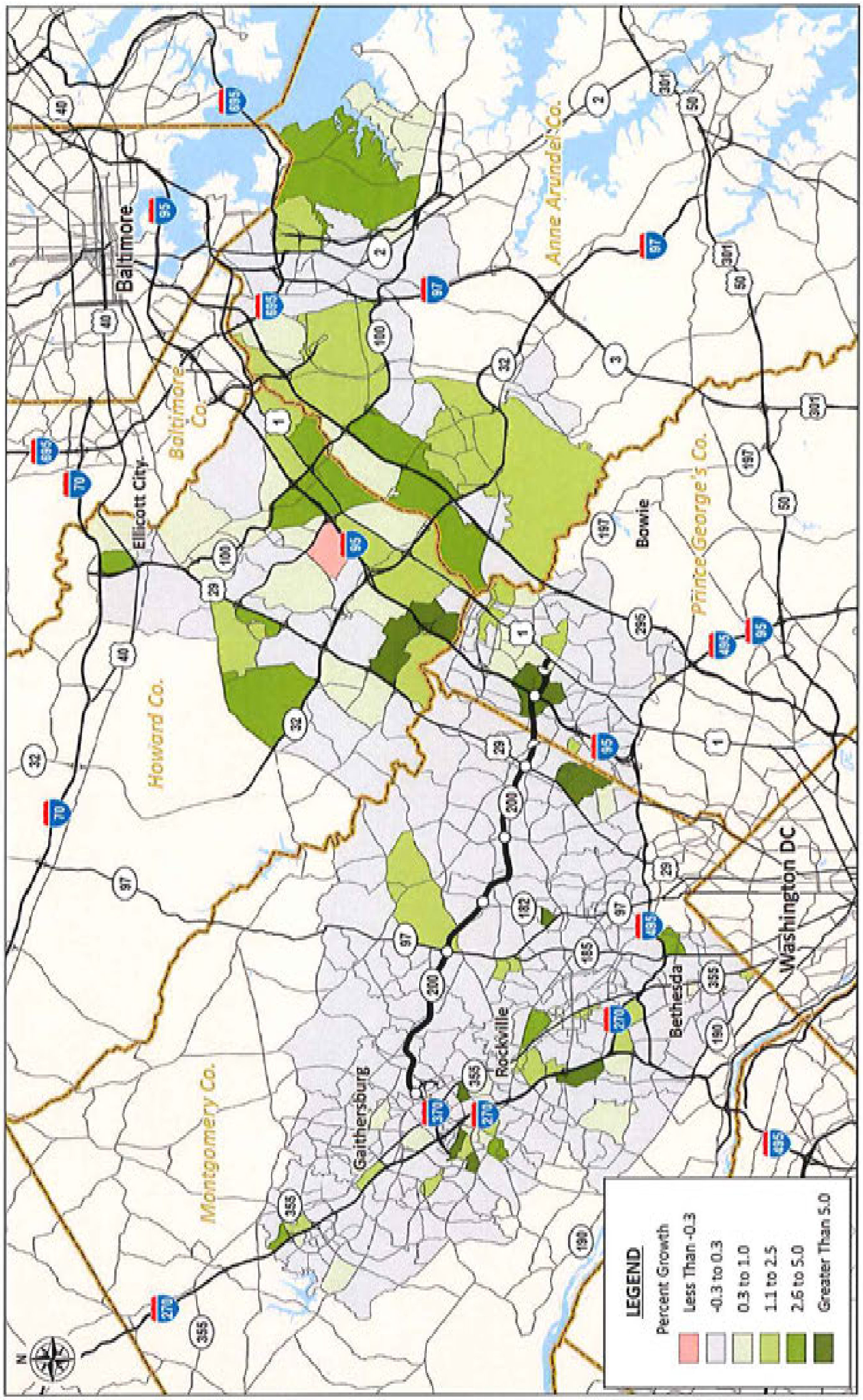


Figure 4-8
Average Annual Employment Growth by TAZ
2014 - 2020

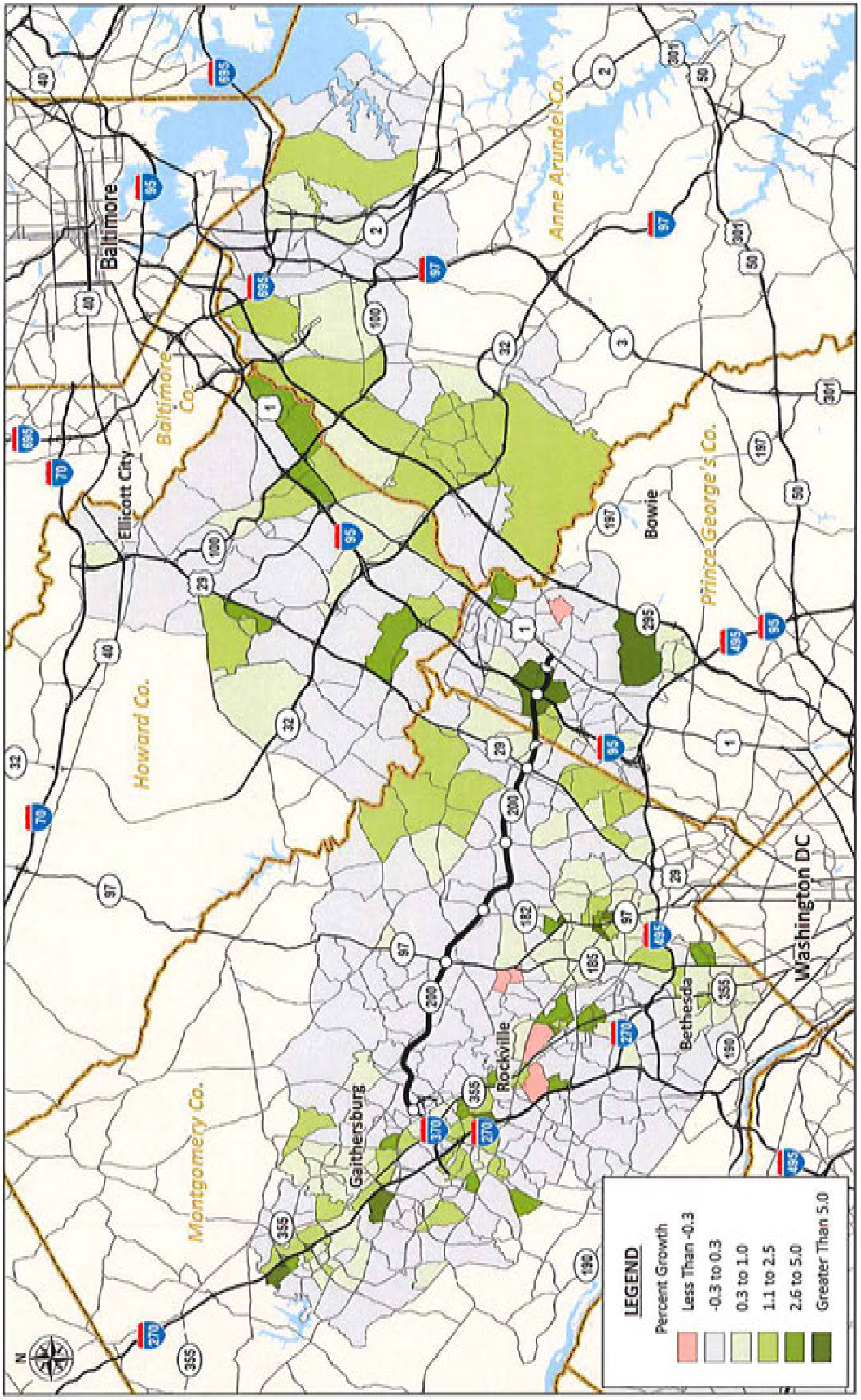


Figure 4-9
Average Annual Employment Growth by TAZ
2020 - 2040

Regarding employment, the estimates are more complex than population estimates for a variety of definitional reasons. The historical employment data shown in **Table 4-1** (previously shown) are from the Bureau of Economic Analysis (BEA). The BEA dataset encompasses a broad definition of employment, which includes proprietorships and partnerships and provides the most comprehensive review of changes in total at-place employment by industry category over time. In contrast, the Bureau of Labor Statistics (BLS) employment dataset only includes workers covered by state and federal unemployment insurance laws. The MWCOG forecasts are developed using BLS employment data plus adjustment factors for self-employed and military deployment, but not for proprietorships or partnerships. The BEA data are therefore often substantially higher than the MWCOG forecasts. As indicated, the comparison of jurisdictional forecast employment growth from different sources in **Figure 4-5** (previously shown) is based on different definitions of employment. The forecasts presented in this section (referred to as "RPG Final" in the previously shown **Figure 4-5**) use the MWCOG employment definitions to ensure consistency and compatibility in the travel demand model validation process.

4.5.2 Summary of Forecast Differences

Table 4-3 shows a comparison between the final forecasts and the base MWCOG Round 8.3 forecasts. Positive differences indicate upward forecast adjustments were made and negative differences indicate downward adjustments were made. For example, a net reduction in population of 70,000 in Washington, D.C., was made to the MWCOG forecast for 2040. Growth is still forecasted for Washington, D.C., between 2030 and 2040, but just not at the magnitude forecasted by MWCOG.

Table 4-3
Differences Between Final Forecasts and Base MWCOG Round 8.3 Forecasts

Region Name	2015	2020	2025	2030	2040
	Population (thousands)				
Anne Arundel	6	5	9	13	20
Howard	3	4	11	13	18
Frederick	3	0	0	0	0
Montgomery	10	4	16	27	69
Prince George's	23	19	16	15	7
District of Columbia	7	-12	-27	-47	-70
Total 5 Counties + DC	**51**	**19**	**26**	**22**	**44**
	Employment (thousands)				
Anne Arundel	-1	-5	-5	-13	-8
Howard	-1	-4	-8	-13	-20
Frederick	0	0	-1	-1	-2
Montgomery	2	-12	-3	-10	-14
Prince George's	0	-7	-24	-35	-71
District of Columbia	0	-15	-15	-23	-27
Total 5 Counties + DC	**1**	**-42**	**-57**	**-95**	**-142**

An overarching concern with the base MWCOG Round 8.3 forecasts is the growing imbalance between the forecasted number of jobs and the lack of housing in the region to supply those workers. This is reflected in the bottom-line reductions in employment and increases in population shown in **Table 4-3** (shown previously). Also reflected in the adjustments are several trends that are anticipated to converge towards a general correction to the jobs/housing balance over time:

- There is increased market acceptance of mixed-use neighborhoods. The market is increasingly more interested in accessibility to proximate jobs than in historic environmental concerns that promoted exclusive residential conclaves such as noise, traffic, and design conformity.
- There are concerns about housing affordability. The market is signaling that affordable housing units may rely less on large residences with a high degree of privacy and more on smaller residential units (1,000 square feet or lower) in communities with a greater reliance on shared civic and retail experiences.
- Connectivity between jobs and housing resources is improving. The recession demonstrated the resiliency of housing units that were well-connected to jobs as most of the region's foreclosures occurred in exurban jurisdictions with a relative lack of proximate job opportunities.

Figure 4-10 and **Figure 4-11** show the population differences by TAZ between the final forecasts and the base MWCOG forecast for 2020 and 2040, respectively. **Figure 4-12** and **Figure 4-13** show the same for employment. The balancing of macroeconomic forces, localized quantitative factors that influence development suitability and market response, as well as site-specific or property concerns results in some notable adjustments at the TAZ level for many of the key activity centers in the Primary Market Area. Several notable changes are summarized in **Table 4-4**.

4.6 Conclusions

Population and employment forecasts are a key input for developing trip generation estimates, the first step in building trip tables within the MWCOG travel demand model, and ultimately estimating demand for the ICC corridor. Reviewing these forecasts as part of a corridor growth assessment is thus an important step, particularly in context of the changing economic conditions in the past several years. Adjustments to the base MWCOG forecasts were made by RPG, who provided independent economic growth projections throughout the Washington, D.C., metropolitan area as part of this study. RPG's work focused on reviewing economic conditions and major development plans to produce independent forecasts of population and employment in the Primary Market Area for the ICC.

One overarching trend in RPG's independent forecasts is that, compared to the base MWCOG forecasts, a lower number of jobs are predicted for the five counties closest to the ICC and Washington, D.C., (referred to as the six Primary Jurisdictions). A steady lowering from the base MWCOG forecasts for employment is predicted, with a total of 142,000 fewer jobs in 2040. Another overarching trend is a higher population in the Primary Jurisdictions that predicted in the base MWCOG forecasts, with 44,000 more residents by 2040. The notable exception to this trend is Washington, D.C. A continued increase in population is predicted in Washington, D.C., but growth is slowed notably from the rates projected in the base MWCOG forecasts. Finally, Montgomery County, which includes much of the Primary Market Area for ICC, is predicted to be the best positioned to attract both residential and commercial growth of any of the Primary Jurisdictions.

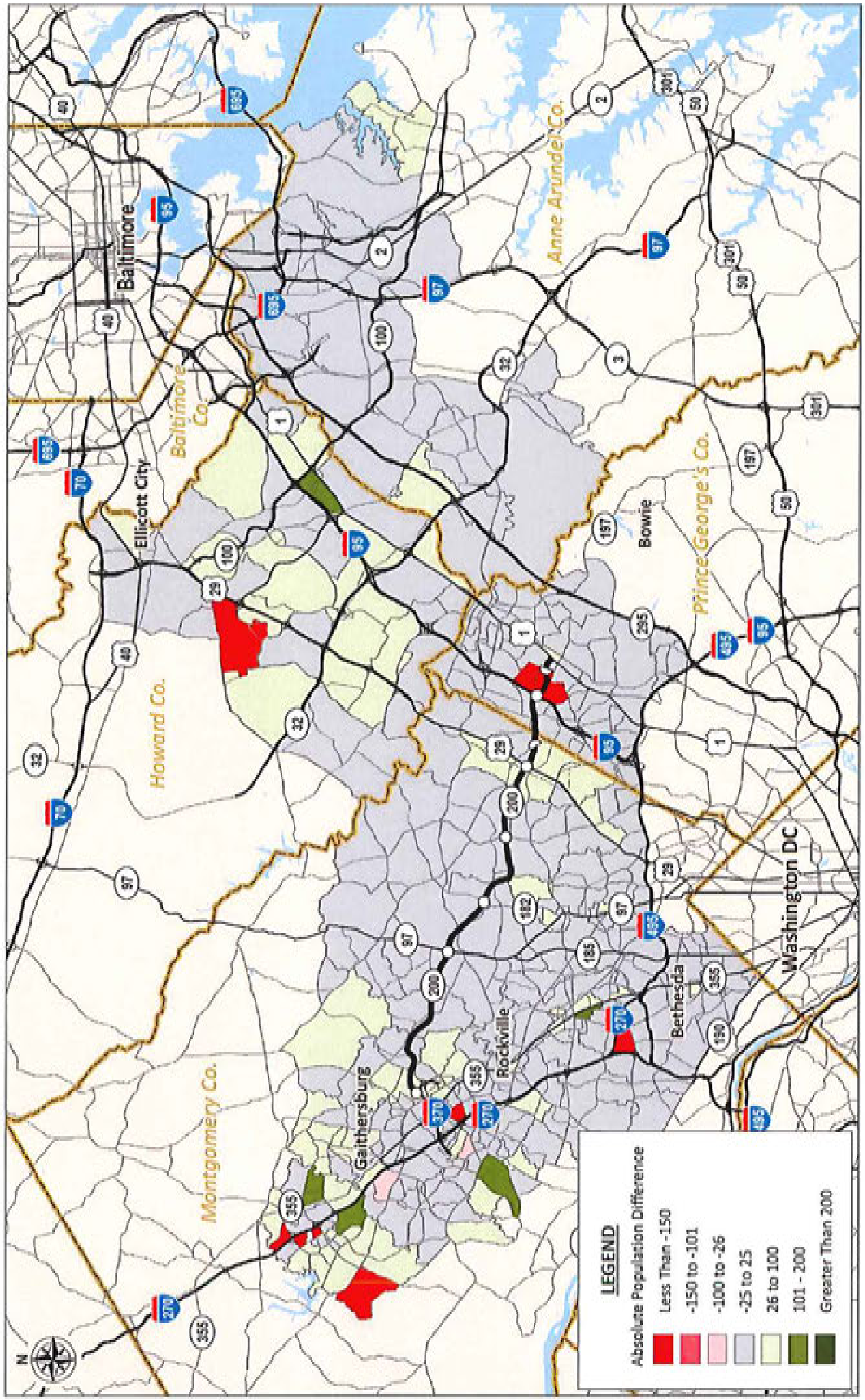


Figure 4-10
Population Forecast Difference
Final RPG vs. Base MWCOG 2020

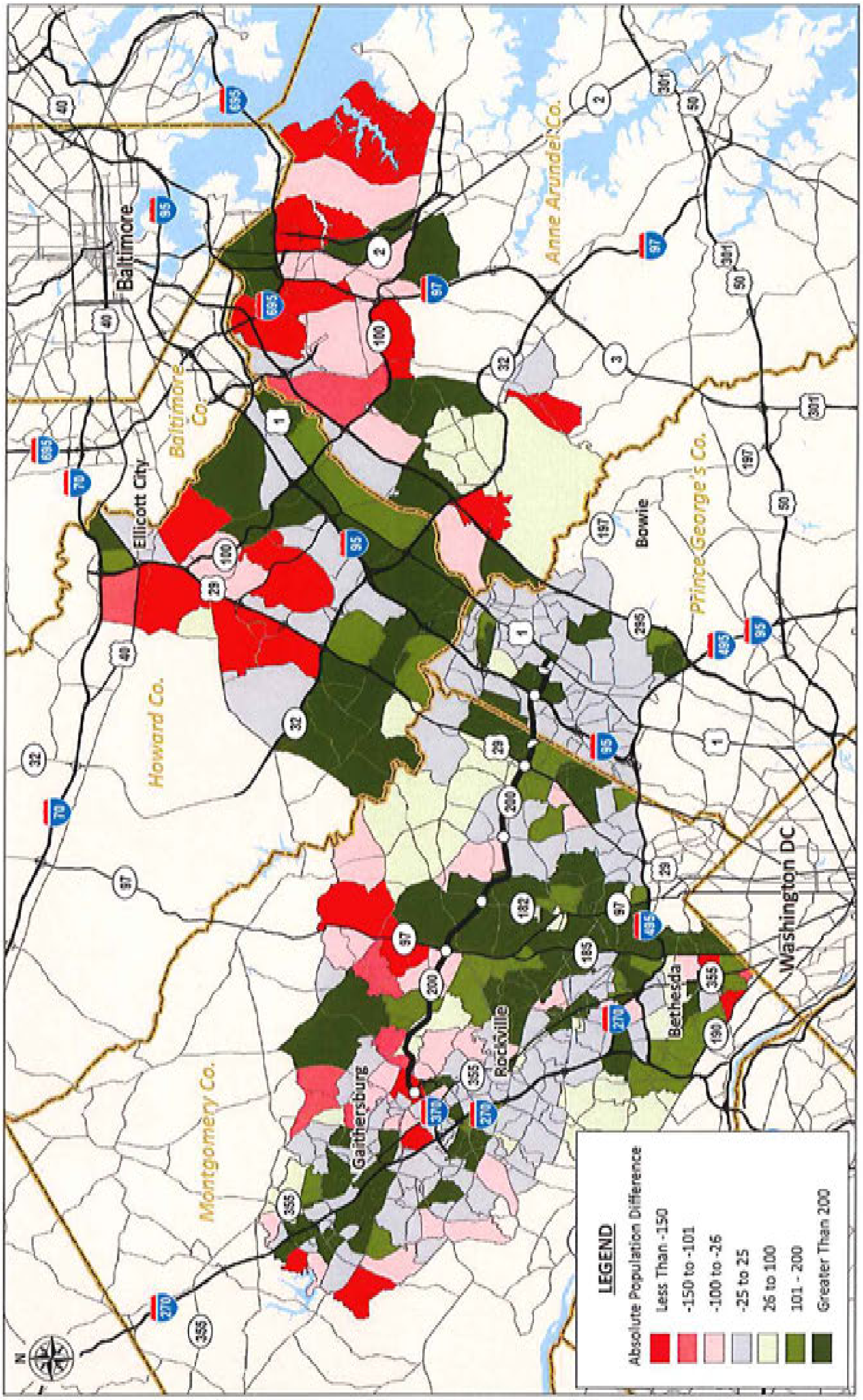


Figure 4-11
Population Forecast Difference
Final RPG vs. Base MWCOG 2040

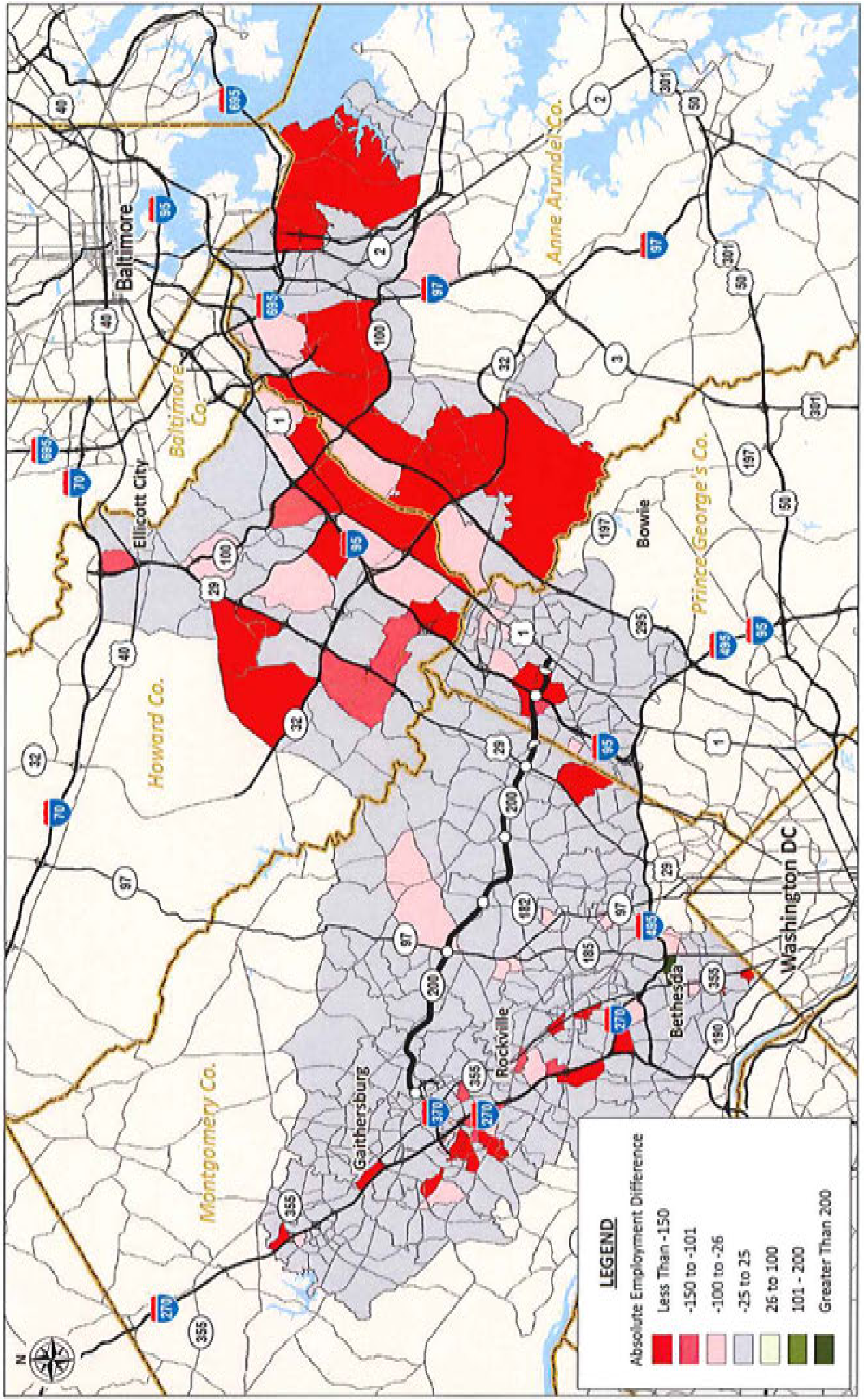


Figure 4-12
Employment Forecast Difference
Final RPG vs. Base MWCOG 2020

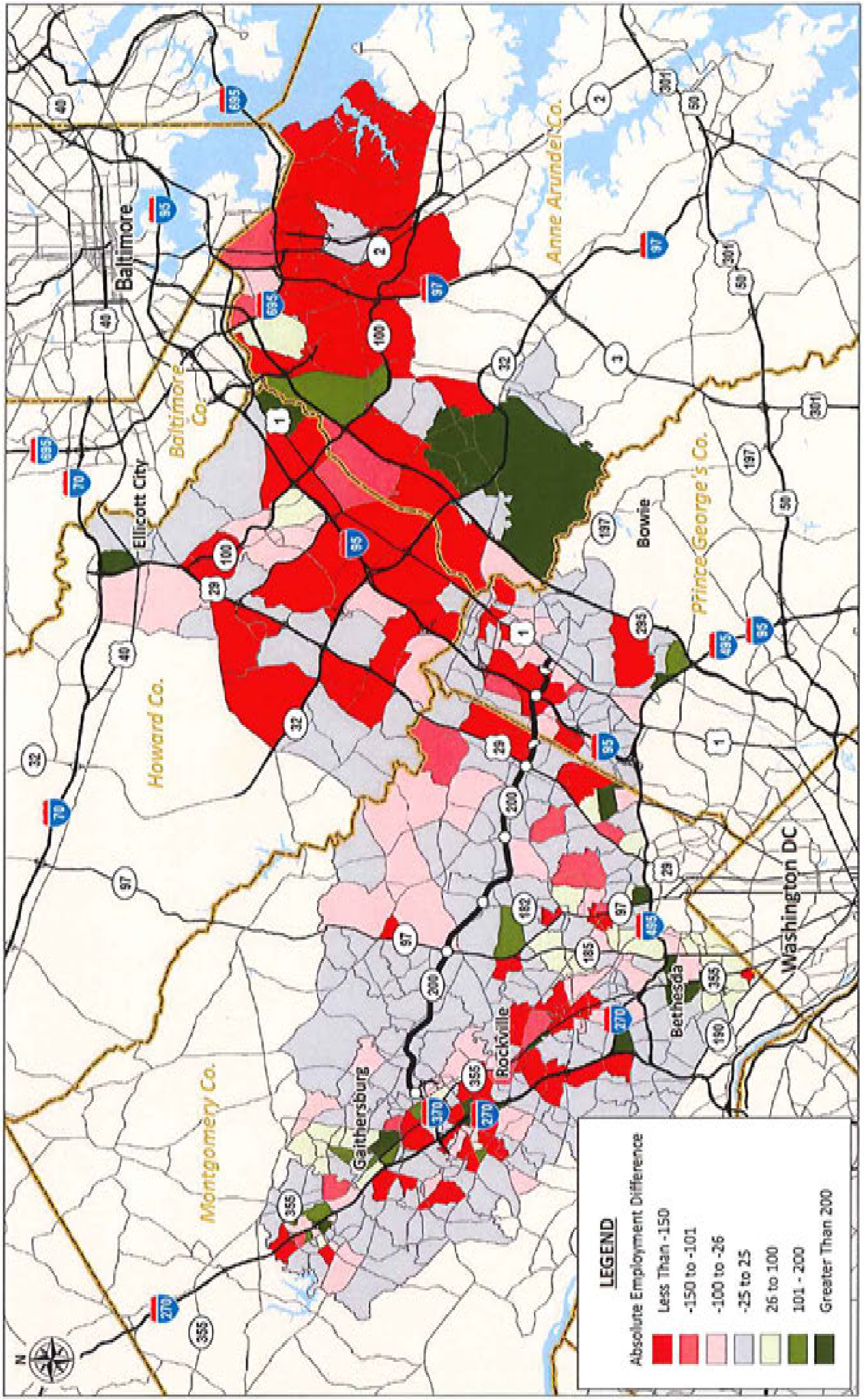


Figure 4-13
Employment Forecast Difference
Final RPG vs. Base MWCOG 2040

Table 4-4
Notable Changes from Base Forecasts in Primary Market Area

Geographic Area	Changes
BRAC Federal Employment Areas	The MWCOG cooperative forecasting process incorporates federal planning processes such as Base Realignment and Closure (BRAC) activities for the near-term but does not forecast additional actions for the longer term. The final forecasts for 2025 through 2040 assume subsequent BRAC actions will occur at Fort Meade in western Anne Arundel County, the U.S. Food and Drug Administration headquarters site in White Oak in southeastern Montgomery County, and the National Institutes of Health site in Bethesda in southwestern Montgomery County. These industry sectors (military intelligence and life sciences) will continue to be growth sectors for the federal government and all three sites will still have growth potential on centrally located but secure campuses.
Great Seneca Science Corridor	A Johns Hopkins University proposal for development of the Banks Farm, one of the last remaining greenfield sites in the Great Seneca Science Corridor, leverages a key location at the western end of the ICC / I-370 corridor. However, the complexity of the project will slow initial development in this area. Over time, development will occur, but is predicted to be a slightly greater mix of locally-serving retail and professional services than the negligible amount included in the Round 8.3 forecast.
White Oak Science Gateway	The White Oak Science Gateway, at the junction of the ICC and US 29, is the most recently designated science center in Montgomery County per the Master Plan adopted in 2014. This plan leverages the relatively new relocation of the Food and Drug Administration (FDA) offices on New Hampshire Avenue and adjacent land for future development. The FDA property is anticipated to see some continued employment growth beyond what is included in the Round 8.3 forecasts. Accessibility challenges associated with adjacent development will limit commercial development north of the FDA site, but the need for additional housing near the FDA site and the regional core is anticipated to result in an increase of residential growth beyond the Round 8.3 forecasts over time.
Konterra	The Konterra activity center, at the junction of I-95 and the ICC, is a planned mixed use center anchored by more than 5 million square feet of retail development. The high levels of auto accessibility for this activity center is anticipated to result in a mix of commercial and residential development. However lower levels of retail development are anticipated, and the entire project is anticipated to have a slower pace of growth, particularly in the near term.
White Flint	The White Flint activity center, located along MD 355 about five miles south of the ICC, is one of the faster-growing mixed-use centers. The MidPike Plaza redevelopment's first phase began occupancy within 5 years of the Sector Plan adoption. The White Flint Sector Plan envisions growth in both residential and commercial development, but as with most mixed-use sites in the Primary Market Area, the forecast is anticipated to be more residentially oriented over time than reflected in the base MWCOG Round 8.3 forecasts.

Table 4-4 (Continued)
Notable Changes from Base Forecasts in Primary Market Area

Geographic Area	Changes
US 1 Corridor	The US 1 corridor in Howard County is beginning a transformation from a predominantly strip commercial and industrial set of uses to a series of residentially-oriented nodes, generally anchored by MARC train station proximity. As with most mixed-use sites in the Primary Market Area, the Howard County portion of the US 1 corridor is forecasted to see more residential, and slightly less commercial, development than included in the Round 8.3 forecasts.
Central Montgomery County	Montgomery County has a substantial amount of aging, post-World War II housing south of the ICC between Rock Creek and the Northwest Branch. The County is channeling growth into transit-served activity centers such as Glenmont, Wheaton, and Kensington and seeking to preserve the single-family residential neighborhoods. However, the combination of the affordability and accessibility provided by the ICC and the emerging Bus Rapid Transit network elements is anticipated to facilitate increased population growth through accessory apartments and minor re-subdivisions in residential zones.
BWI Airport Vicinity	BWI Airport is located in northern Anne Arundel County about twenty miles northeast of the ICC / I-95 interchange. The high levels of international accessibility associated with BWI airport connections, as well as the ongoing branding of the adjacent Arundel Mills area as airport-oriented tourism, make this area one where jobs are forecasted to increase at a rate slightly higher than the base MWCOG forecasts.

Chapter 5

Model Development and Calibration

As part of this Comprehensive Traffic and Revenue Study, CDM Smith engaged in a substantial calibration effort of the Metropolitan Washington Council of Governments (MWCOG) regional travel demand model, particularly on the ICC and the surrounding influence area. This is standard practice when conducting a corridor-level study, particularly a comprehensive traffic and revenue study of a toll project such as the ICC. Regional models cover a significant area and are validated primarily against regional statistics such as vehicle miles traveled and traffic volumes across regional screenlines. This regional validation does not ensure a good calibration within a specific corridor. This requires the need to spend effort to ensure the specific corridor under consideration (i.e., the ICC corridor) is refined to match volumes, speeds, and travel patterns to the best extent possible. This chapter discusses the calibration approach and provides several measures of effectiveness of volume and speed calibration summaries for the ICC and for nearby competing and perpendicular routes.

5.1 Description of MWCOG Model

Figure 5-1 shows the regional coverage of the MWCOG model. The model itself encompasses several counties in the Washington, D.C., and Baltimore metropolitan region, including Montgomery, Howard, Prince Georges, Anne Arundel, Frederick, and Baltimore counties as well as the District of Colombia. It contains 3,722 Traffic Analysis Zones (TAZs) with 25,000 roadway miles. The model includes the Washington, D.C., metropolitan area, extending south into Virginia and north into Maryland, terminating at the outskirts of Baltimore.

Before beginning the calibration process, adjustments were made to the base and future-year model socioeconomic assumptions (population and employment data and forecasts) for the region. This modified socioeconomic dataset was then used in the MWCOG model to produce revised trip tables. A summary of the socioeconomic dataset and adjustments made over the base MWCOG model is included in **Chapter 4**.

5.2 CDM Smith Model Calibration Process

The FY 2014 MWCOG model, after incorporating the adjustments to the socioeconomic dataset made by the independent economist, Renaissance Planning Group (RPG), formed the basis for calibration of the model for the ICC and surrounding area. Calibration consisted of several interrelated steps, as shown in **Figure 5-2**. These calibration steps mainly consisted of refinements and adjustments to the model roadway network, trip tables, and toll assignment inputs. Detailed descriptions of each step can be found below.

5.2.1 Trip Table Splitting

The trip tables in the original MWCOG model represent an average weekday for an AM Peak Period (6:00– 9:00 AM), a PM Peak Period (3:00– 7:00 PM), a Midday period (9:00 AM – 3:00 PM), and a Nighttime period (7:00 PM – 6:00 AM). To better align the model with the current time of day toll rate schedule utilized by the ICC, CDM Smith performed trip table splits and shifts of the current trip tables into six time periods. In order to perform the trip table refinement, CDM Smith calculated traffic volume totals for all screenlines within the study area on an hourly basis. Trip tables were then split

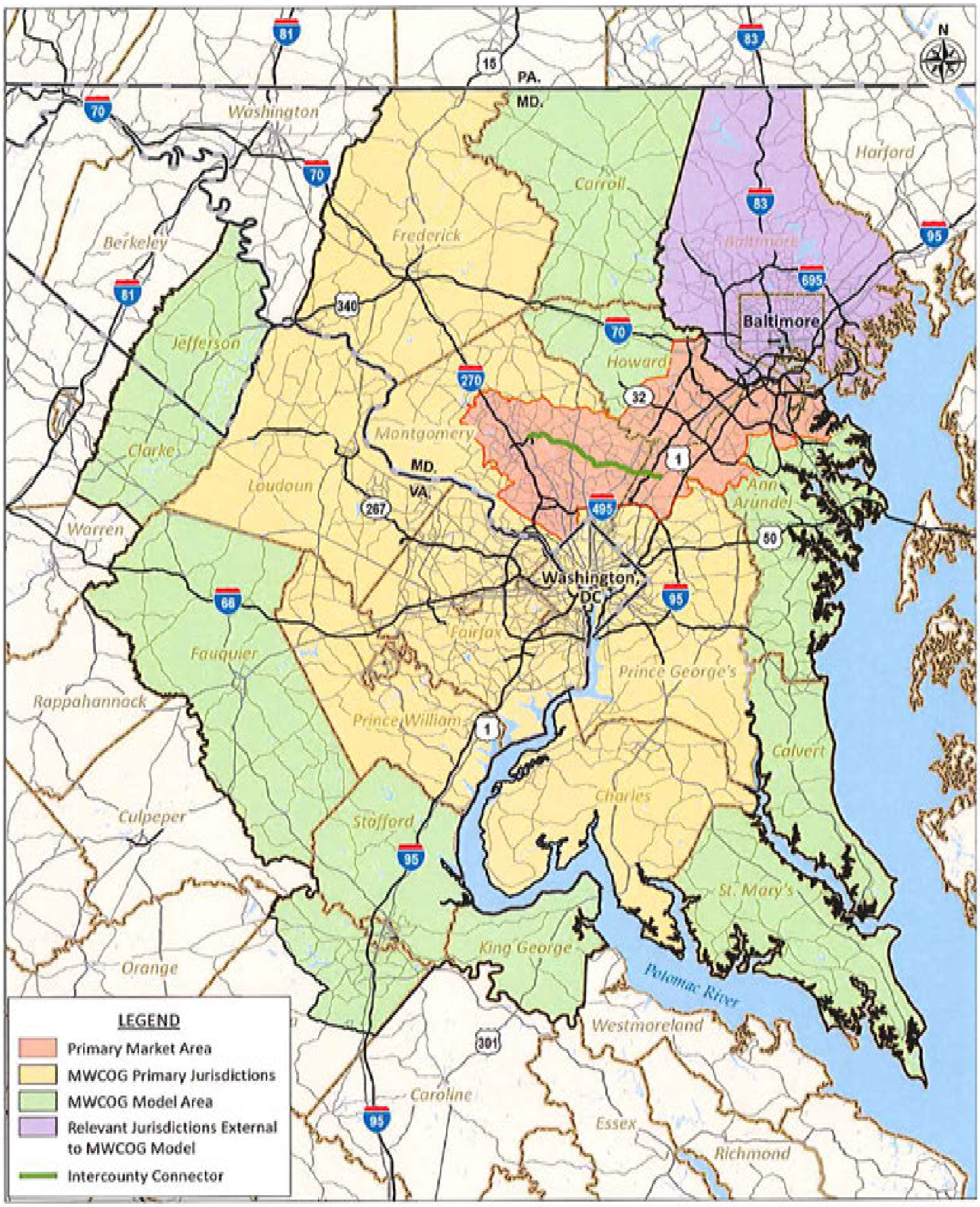


Figure 5-1
MWCOG Model Area

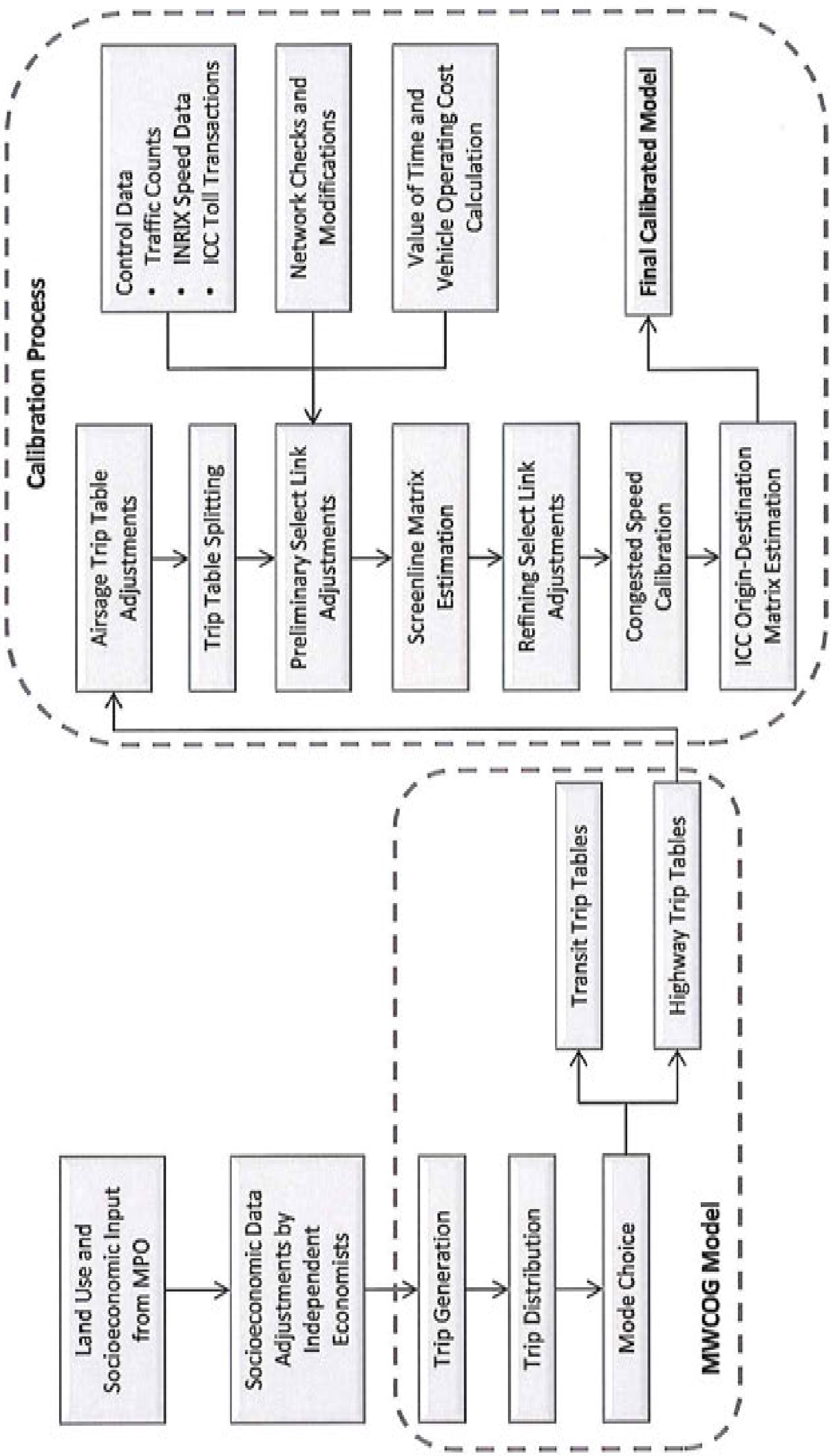


Figure 5-2
Calibration Process Diagram

or shifted using the proportion of traffic volumes falling within specific hours or periods, as detailed in **Table 5-1**. The final time periods which line up with current ICC time of day toll schedule are as follows:

1. Morning Off-Peak Period (5:00 to 6:00 AM)
2. AM Peak Period (6:00 to 9:00 AM)
3. Midday Off-Peak Period (9:00 AM to 4:00 PM)
4. PM Peak Period (4:00 to 7:00 PM)
5. Evening Off-Peak Period (7:00 to 11:00 PM)
6. Overnight Period (7:00 PM to 5:00 AM)

Table 5-1
Trip Table Refinement into Six Time Periods

Hour Beginning	ICC Toll Schedule Time Periods	Original MWCOG Model Time Periods	Volume as a Percent of Period	Revised Model Time Periods
0:00	Overnight	Nighttime	3%	Overnight
1:00	Overnight	Nighttime	2%	Overnight
2:00	Overnight	Nighttime	1%	Overnight
3:00	Overnight	Nighttime	2%	Overnight
4:00	Overnight	Nighttime	4%	Overnight
5:00	Off-Peak	Nighttime	12%	Morning Off-Peak
6:00	Peak	AM Peak	28%	AM Peak
7:00	Peak	AM Peak	36%	AM Peak
8:00	Peak	AM Peak	37%	AM Peak
9:00	Off-Peak	Midday	18%	Midday Off-Peak
10:00	Off-Peak	Midday	15%	Midday Off-Peak
11:00	Off-Peak	Midday	15%	Midday Off-Peak
12:00	Off-Peak	Midday	16%	Midday Off-Peak
13:00	Off-Peak	Midday	16%	Midday Off-Peak
14:00	Off-Peak	Midday	19%	Midday Off-Peak
15:00	Off-Peak	PM Peak	21%	Midday Off-Peak
16:00	Peak	PM Peak	26%	PM Peak
17:00	Peak	PM Peak	28%	PM Peak
18:00	Peak	PM Peak	25%	PM Peak
19:00	Off-Peak	Nighttime	24%	Evening Off-Peak
20:00	Off-Peak	Nighttime	19%	Evening Off-Peak
21:00	Off-Peak	Nighttime	16%	Evening Off-Peak
22:00	Off-Peak	Nighttime	12%	Evening Off-Peak
23:00	Overnight	Nighttime	5%	Overnight

5.2.2 Validation of Network Configuration

In order to properly reflect roadway detail on the ICC and on adjacent roadways, CDM Smith conducted a detailed review of network attributes in the ICC region of the MWCOG model, making adjustments as necessary to reflect FY 2014 roadway conditions. In addition, CDM Smith added, in a separate network, all improvements made to the ICC and I-95 in FY 2015. Roadway attribute review and adjustments included the following:

- Recoding the physical link configuration of the ICC and I-370 to more accurately reflect existing conditions;
- Coding High Occupancy Vehicle (HOV), Mainline, and Collector-Distributor (CD) lane configurations on I-295, I-495, and I-95;
- Reviewing and adjusting link capacity, including the number of lanes;
- Reviewing distances on roadway links and highway ramps on the ICC and major competing routes; and
- Reviewing and adjusting free-flow speeds based on INRIX data and observed conditions.

5.2.3 AirSage Trip Table Adjustments

One source of Origin-Destination (O-D) data is cellular network data that has been processed for a specific area. AirSage partners with two wireless carriers to collect and analyze real-time travel patterns based on mobile signals. AirSage then summarizes this information into a superzone-level person-trip matrix.

CDM Smith reviewed the person-trip matrix generated by AirSage at a superzone level, reviewing major O-D pairs against the initial movements generated by the MWCOG trip tables, with a major emphasis on movements that would potentially use the ICC. Adjustments were ultimately made to the movement pair from Baltimore to Washington, D.C., in order to better reflect the AirSage data. The demand movements between Washington, D.C., and Baltimore were overstated in the MWCOG model, leading to an over-assignment of volumes on I-95 and the eastern end of the ICC. The adjustments made to these patterns helped to improve the calibration on I-95 and mitigate the over-assignment of traffic volumes the MWCOG model was producing on the eastern end of the ICC.

5.2.4 Matrix Estimation

In order to properly calibrate the model to FY 2014 volumes across all screenlines and to ramp-to-ramp movement data on the ICC, an automated process was employed that involved iteratively adjusting the input assignment trip table until assigned volumes matched screenline counts within a reasonable range. This automated adjustment process, called Matrix Estimation (ME), was performed at two points during the model calibration process. The first ME process, performed around the midpoint of the calibration process, involved calibrating the trip table to totals for passenger cars and commercial vehicles on an overall screenline basis. The second ME process, performed at the very end of calibration, focused on the ICC corridor and calibrated on an O-D basis for passenger cars and commercial vehicles, split between ETC and video users. For each ME process, trip length distribution calculations were performed for movements travelling through any of the calibration screenlines. These tests, outlined in the next section, serve as a high-level check to ensuring that trip length distributions had not changed significantly as a result of ME process.

5.2.5 Select Link Trip Table Adjustment

During the calibration process, volumes on individual links were adjusted as necessary, both before and after the initial ME process. These adjustments helped fine-tune volumes on screenline links and along ICC mainline segments and ramps.

5.2.6 Value of Time and Vehicle Operating Cost Assumptions

As two major costs to the tolling algorithm, Value of Time (VOT) and Vehicle Operating Cost (VOC) were adjusted in the model during the calibration process. Input VOT was calculated based on the results of a stated preference survey performed by Resource Systems Group (RSG), as detailed in **Chapter 3**. For passenger cars, a VOT of $0.214 per minute for peak and shoulder periods was used, while a slightly lower VOT of $0.20 per minute for midday and off peak periods was used. The VOT for commercial vehicles was assumed at twice the passenger car value. VOC was estimated using fuel price data, vehicle fuel efficiency, vehicle fleet data, and fuel forecast information. Values for VOC were estimated at $0.216 per mile for passenger cars and $0.648 per mile for commercial vehicles.

5.2.7 Congested Speed Calibration

Once total volumes along the study corridor were reasonably well-calibrated, the speeds and bottleneck locations of the general purpose lanes were compared against observed travel time and INRIX speed data by model period. If speeds matched well with a good volume calibration, the Volume-Delay Function (VDF) was not changed. If speeds did not match well at a calibrated volume, the VDF was altered for the model links.

5.3 Calibration Results

The results of the calibration of the MWCOG model are presented in this section.

5.3.1 Trip Length Distribution

As a validation of the ME process, trip length distributions were calculated for trips travelling through any of the calibration screenlines. The results, shown in **Figures 5-3 and 5-4**, show trip length distributions at several stages of calibration:

- The initial matrices, immediately after the split into the six model periods (Original);
- After network and select link model adjustments, prior to the screenline-based Matrix Estimation (Pre-ME1);
- Immediately after the screenline-based Matrix Estimation (Post-ME1);
- After further model refinements, including select link adjustments and speed calibration, prior to the O-D Matrix Estimation for ICC (Pre-ME2); and
- After the O-D Matrix Estimation for ICC (Post-ME2).

Table 5-2 displays selected percentiles for trip length for these steps in the calibration process. As shown in the figures and table below, the difference in the distribution of trip lengths has not changed significantly as a result of the ME process. The most dramatic change occurs as a result of the initial AirSage and screenline adjustments, and this change is almost imperceptible on the trip length distribution graphs. This indicates that the ME processes are working properly and have improved calibration while maintaining the overall trip characteristics of the original model.

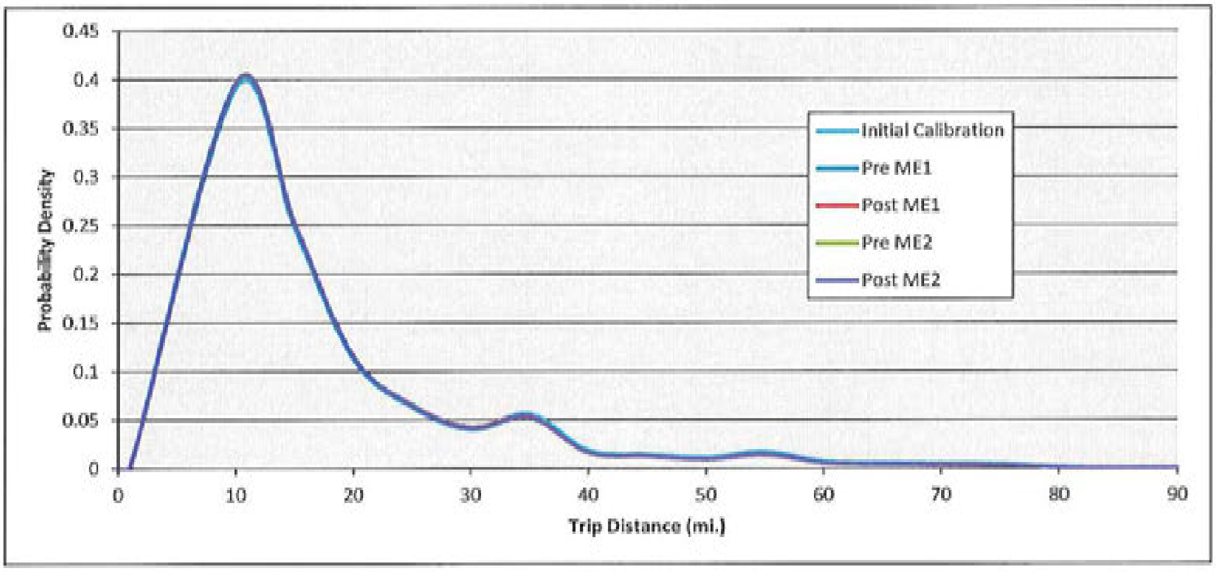


Figure 5-3
Trip Length Distribution During Calibration Process

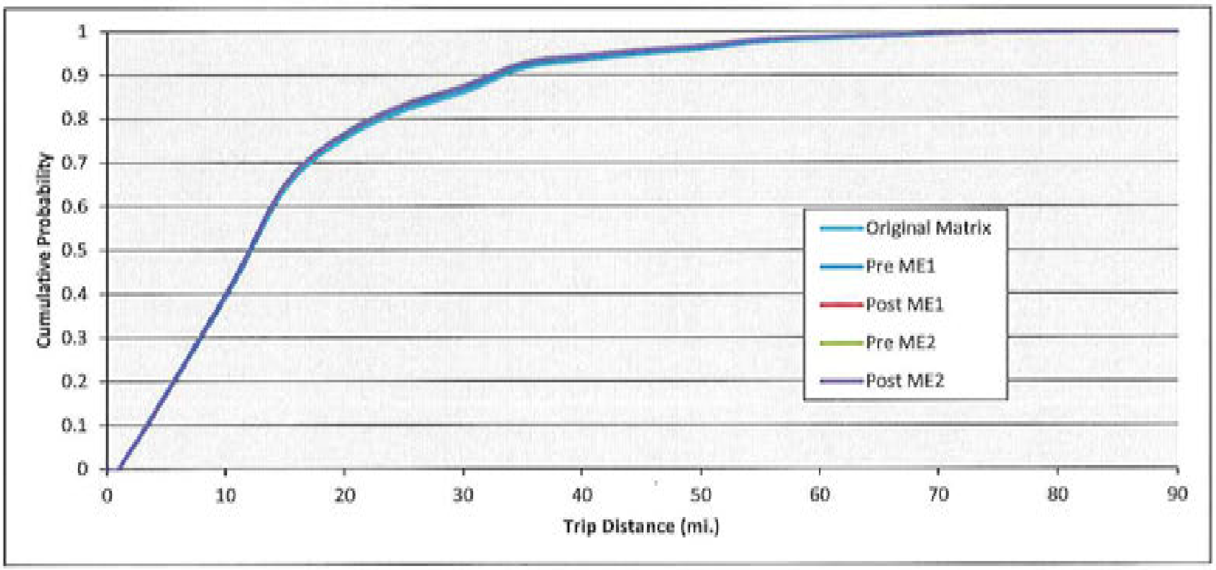


Figure 5-4
Cumulative Trip Length Distribution During Calibration Process

Table 5-2
Selected Trip Length Percentiles

Percentile	Original	Pre ME1	Post ME1	Pre ME2	Post ME2
1%	0.42	0.42	0.42	0.42	0.42
5%	1.09	1.08	1.08	1.08	1.08
25%	3.37	3.33	3.33	3.33	3.33
50%	7.07	6.94	6.96	6.93	6.95
75%	15.16	14.65	14.60	14.52	14.56
95%	43.02	41.83	39.94	39.85	39.98
99%	69.53	69.05	67.97	67.93	68.01
Average	13.41	13.04	12.77	12.73	12.77

5.3.2 Screenline Volume Comparison

In this section, link volumes are compared to counts along regional screenlines, shown in **Figure 5-5.** Roadway volume comparisons are presented in the form of percent Root Mean Squared Error (RMSE) and through count-volume comparisons on both an aggregate and individual link basis.

5.3.3 Root Mean Squared Error

Table 5-3 shows a summary of the model percent RMSE grouped by roadway volume, alongside acceptable lower and upper tolerances. In all cases, roadway percent RMSE falls within tolerance limits and only the two classes of less than 5,000 vehicles per day and 30,000 – 50,000 vehicles per day fall above the lower acceptance limits.

5.3.4 Count-Volume Comparison

In **Table 5-4**, screenlines are compared to count values on a total basis. While variations in individual screenline links may differ, screenlines vary from actual traffic counts by no more than 6.9 percent and no less than -5.0 percent on a total daily basis.

For a more fine-grain comparison, scatterplots of counts versus model volume for screenlines are presented in **Figure 5-6**. Scatterplot data show counts for all screenline and ICC ramp and mainline links against the corresponding model volumes. Each scatterplot is fitted with a linear trend line, and the corresponding factor and R-squared value are printed on each plot. Trend line factors close to 1 represent calibrations that are close to observed values on a total basis. R-squared values close to 1 represent a roadway calibration that does not vary greatly from counts on a link-by-link basis, provided that the trend line factor is also close to 1. **Figure 5-6** shows tightly clustered points for all time periods; all trend line factors are between 0.975 and 1.048 and R-squared values are at least 0.94.

5.4 ICC Origin-Destination Volumes

Calibration of the tolled traffic diversion, as the degree of the relative attractiveness of the ICC corridor in the base year, is measured on an O-D basis by vehicle and payment type. **Table 5-5** shows comparisons of gantry-to-gantry movement pairs for vehicles against count data from toll transactions on a total basis. As shown in the comparison, O-D movements in the model match the traffic counts closely. For any one period O-D pair, no movement is off by more than 125 vehicles. On a total basis, the difference amounts to approximately 2,600 vehicles, or 4 percent of the total trip count.

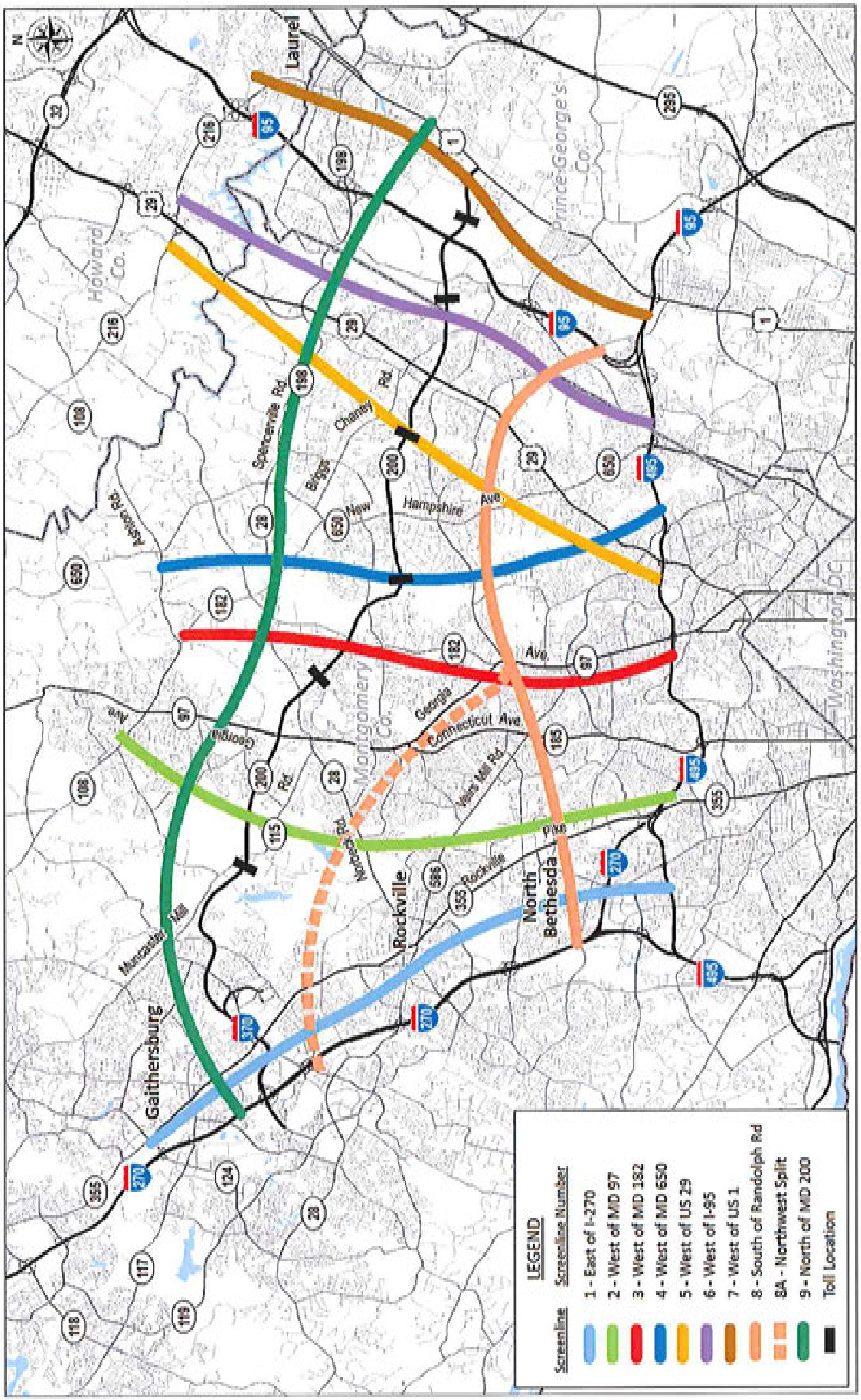


Figure 5-5
Intercounty Connector Screenline Locations

Table 5-3
Root Mean Squared Error for Screenline Links

Veh. Per Day	Count	Avg	Avg	Model %RMSE	Low Range	High Range
<5K	54	2,732	2,642	53%	45%	100%
5K - 10K	57	7,394	6,813	28%	35%	45%
10K - 15K	37	12,367	11,545	20%	27%	35%
15K - 20K	37	17,676	17,072	17%	25%	35%
20K - 30K	37	22,971	22,660	8%	15%	27%
30K - 50K	21	36,867	34,435	20%	15%	25%
50K - 60K	6	53,562	55,504	9%	10%	20%
> 60K	20	105,946	109,880	8%	10%	29%
TOTAL	269	21,357	21,123	18%	35%	45%

Table 5-4
Count-Volume Comparison by Screenline Total

Screenline	Counts	Base	Diff	%Diff
1	674,109	641,542	-32,566	-4.8%
2	459,691	491,431	31,740	6.9%
3	491,867	483,945	-7,922	-1.6%
4	441,787	455,295	13,508	3.1%
5	469,983	449,522	-20,461	-4.4%
6	432,527	424,811	-7,716	-1.8%
7	399,222	380,000	-19,222	-4.8%
8	856,682	862,125	5,443	0.6%
8A	339,245	322,386	-16,859	-5.0%
9	706,292	689,593	-16,699	-2.4%
TOTAL SL	5,271,405	5,200,651	-70,754	-1.3%

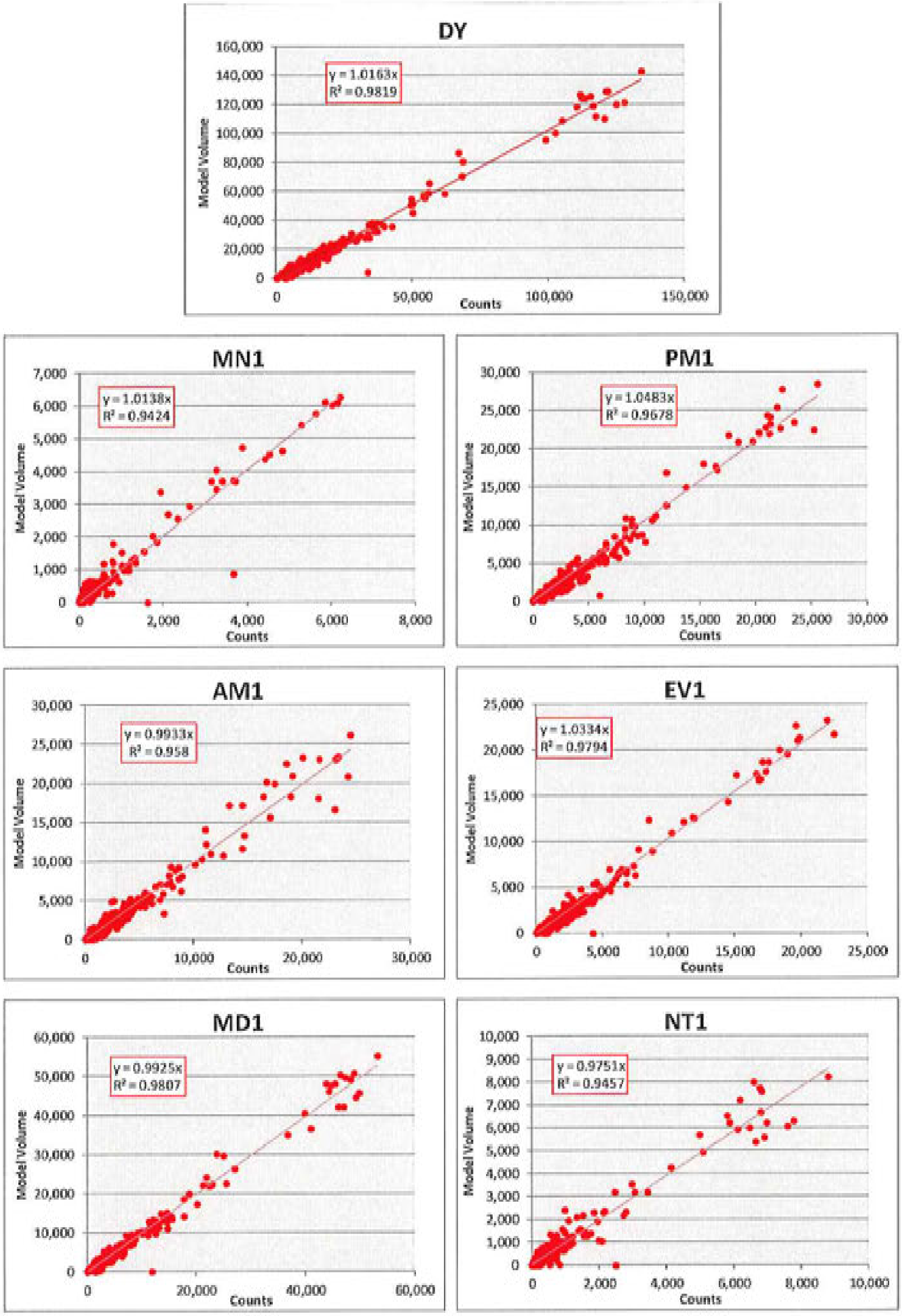


Figure 5-6
Count-Volume Scatterplots

Table 5-5
Summary of ICC Origin-Destination Movements

COUNT TOTALS BY PERIOD

AM1	I-370	MD97	MD182	MD655	US29	I-95
I-370		778	214	455	911	1,879
MD97	1,274		81	187	288	655
MD182	441	92		65	146	321
MD655	480	105	60		143	311
US29	1,110	299	153	129		550
I-95	2,307	652	282	306	699	

MD1	I-370	MD97	MD182	MD655	US29	I-95
I-370		1,874	483	581	1,505	3,142
MD97	1,976		146	230	477	1,038
MD182	549	162		105	216	406
MD655	633	228	107		250	423
US29	1,366	412	169	203		971
I-95	2,753	890	331	357	833	

PM1	I-370	MD97	MD182	MD655	US29	I-95
I-370		1,576	493	534	1,216	2,016
MD97	881		94	116	289	531
MD182	258	109		55	142	223
MD655	528	210	76		154	221
US29	920	289	131	156		611
I-95	1,891	644	268	313	627	

NT1	I-370	MD97	MD182	MD655	US29	I-95
I-370		112	37	32	85	182
MD97	105		8	15	25	63
MD182	37	13		7	15	37
MD655	38	15	10		14	25
US29	101	26	17	17		84
I-95	281	90	47	40	90	

MN1	I-370	MD97	MD182	MD655	US29	I-95
I-370		38	16	21	36	150
MD97	82		6	10	11	61
MD182	16	4		4	7	31
MD655	14	4	2		5	22
US29	60	12	5	4		58
I-95	143	33	11	12	33	

EV1	I-370	MD97	MD182	MD655	US29	I-95
I-370		772	234	206	465	668
MD97	557		50	65	143	258
MD182	156	51		30	77	122
MD655	168	91	42		73	115
US29	443	128	83	84		296
I-95	847	322	163	161	310	

TOTAL	I-370	MD97	MD182	MD655	US29	I-95
I-370		5,145	1,477	1,829	4,218	8,036
MD97	4,874		386	623	1,232	2,605
MD182	1,457	430		265	603	1,140
MD655	1,861	653	296		639	1,118
US29	4,000	1,166	558	593		2,570
I-95	8,221	2,632	1,102	1,188	2,592	

GRAND TOTAL: 63,508

OD-ESTIMATED TOTALS BY PERIOD

AM1	I-370	MD97	MD182	MD655	US29	I-95
I-370		804	326	471	942	1,931
MD97	1,260		130	187	289	652
MD182	445	92		65	154	330
MD655	565	111	56		165	362
US29	1,119	276	176	250		560
I-95	2,423	628	326	370	737	

MD1	I-370	MD97	MD182	MD655	US29	I-95
I-370		1,882	527	628	1,542	3,197
MD97	2,006		145	229	486	1,041
MD182	559	185		105	223	410
MD655	756	227	105		285	473
US29	1,376	407	175	231		987
I-95	2,880	886	345	392	856	

PM1	I-370	MD97	MD182	MD655	US29	I-95
I-370		1,587	516	542	1,241	2,026
MD97	927		96	119	293	534
MD182	310	201		56	148	228
MD655	536	212	77		202	318
US29	930	284	137	187		650
I-95	1,935	640	283	352	650	

NT1	I-370	MD97	MD182	MD655	US29	I-95
I-370		121	43	33	83	179
MD97	111		9	18	24	61
MD182	40	14		10	16	38
MD655	38	20	12		15	26
US29	100	25	17	20		83
I-95	275	89	48	46	93	

MN1	I-370	MD97	MD182	MD655	US29	I-95
I-370		44	20	23	40	156
MD97	86		6	13	14	64
MD182	18	3		7	10	32
MD655	14	6	3		9	24
US29	62	15	7	9		58
I-95	148	35	15	18	37	

EV1	I-370	MD97	MD182	MD655	US29	I-95
I-370		774	237	210	478	686
MD97	588		50	71	155	257
MD182	160	65		31	83	129
MD655	173	96	42		91	135
US29	463	135	86	92		309
I-95	854	333	172	167	315	

TOTAL	I-370	MD97	MD182	MD655	US29	I-95
I-370		5,210	1,668	1,908	4,326	8,174
MD97	4,978		435	636	1,261	2,609
MD182	1,531	561		274	634	1,166
MD655	2,081	672	295		767	1,338
US29	4,050	1,142	599	789		2,648
I-95	8,515	2,610	1,189	1,345	2,688	

GRAND TOTAL: 66,100

COUNT - MODEL

AM1	I-370	MD97	MD182	MD655	US29	I-95
I-370		-31	-112	-16	-31	-52
md97	14		-48	0	-1	3
md182	-4	-1		-1	-8	-8
MD655	-85	-6	3		-21	-51
US29	-9	23	-23	-121		-10
I-95	-116	24	-44	-64	-38	

MD1	I-370	MD97	MD182	MD655	US29	I-95
I-370		-8	-43	-47	-37	-56
md97	-31		1	1	-9	-4
md182	-10	-23		-1	-7	-4
MD655	-123	0	2		-36	-49
US29	-10	5	-6	-28		-16
I-95	-126	5	-14	-35	-24	

PM1	I-370	MD97	MD182	MD655	US29	I-95
I-370		-11	-23	-9	-25	-10
MD97	-46		-2	-3	-5	-3
MD182	-52	-93		0	-5	-5
MD655	-8	-2	-1		-48	-97
US29	-10	5	-6	-31		-40
I-95	-44	4	-15	-39	-23	

NT1	I-370	MD97	MD182	MD655	US29	I-95
I-370		-8	-6	0	1	3
MD97	-6		0	-3	1	2
MD182	-2	0		-3	-1	0
MD655	0	-5	-2		0	-1
US29	0	0	0	-3		0
I-95	6	2	-1	-6	-3	

MN1	I-370	MD97	MD182	MD655	US29	I-95
I-370		-6	-3	-2	-4	-6
MD97	-4		0	-3	-3	-2
MD182	-1	0		-3	-3	-1
MD655	0	-2	-1		-4	-1
US29	-2	-2	-2	-4		0
I-95	-5	-2	-4	-6	-3	

EV1	I-370	MD97	MD182	MD655	US29	I-95
I-370		-2	-3	-5	-13	-17
MD97	-31		0	-6	-12	1
MD182	-4	-14		-1	-6	-7
MD655	-4	-5	0		-18	-20
US29	-20	-7	-4	-8		-13
I-95	-7	-11	-10	-6	-4	

TOTAL	I-370	MD97	MD182	MD655	US29	I-95
I-370		-66	-191	-79	-108	-138
MD97	-104		-49	-13	-29	-4
MD182	-74	-131		-9	-31	-26
MD655	-220	-19	1		-128	-220
US29	-51	24	-41	-196		-78
I-95	-294	21	-87	-157	-95	

TOTAL DIFFERENCE: -2,591

5.5 Travel Speeds

Travel times must be accurately represented in the calibrated model in order to provide the correct level of congestion on alternate routes. This ensures the ICC realizes its proper time savings advantage for applicable movements in the diversion assignment. This section compares the observed travel times for the ICC and major competing routes against the calibrated model congested speeds for each model period. For the purposes of speed calibration, INRIX speed data for FY 2014 was used. Where available, this congested speed data was supplemented with travel time run data collected by CDM Smith staff during route reconnaissance field efforts.

Table 5-6 shows a summary of speed by time period, direction, and roadway against observed speed data. Overall, speeds are represented fairly well in the model. Looking at all roadways by period, only 12 instances occur where speeds are not within 10 miles per hour of the target congested speed. This accounts for 4.1 percent of all roadways by distance on a daily basis and no more than 9.4 percent of roadways by distance in any one period. When filtering for speed differences that are not within the minimum and maximum bounds of speed, only 8 instances remain. These differences total to approximately 2.8 percent of all roadways by distance on a daily basis and no more than 8.8 percent for any one period.

5.6 Conclusions

As part of this Comprehensive Traffic and Revenue Study, CDM Smith engaged in a substantial calibration effort of the MWCOG model, particularly on the ICC and the surrounding influence area. The model itself encompasses several counties in the Washington, D.C., and Baltimore metropolitan region, including Montgomery, Howard, Prince Georges, Anne Arundel, Frederick, and Baltimore counties as well as the District of Colombia. It contains 3,722 Traffic Analysis Zones (TAZs) with 25,000 roadway miles. Before beginning the calibration process, adjustments were made to the base and future year model socioeconomic assumptions (population and employment data and forecasts) for the region, as summarized in **Chapter 4**. This modified socioeconomic dataset was then used in the MWCOG model to produce revised trip tables.

The calibration process consisted of the refinement and adjustment of the model roadway network, trip tables, and toll assignment inputs. CDM Smith conducted a detailed review of network attributes in the ICC region of the MWCOG model and made adjustments as necessary to reflect FY 2014 roadway conditions and the improvements made to the ICC and I-95 in FY 2015. Adjustments to the overall trip tables were made based on the person-trip matrix generated by AirSage at a superzone level, reviewing major Origin and Destination (O-D) pairs against the initial MWCOG movements, with a major emphasis on movements that would potentially use the ICC. The trip tables were then split and shifted as needed into six time periods, so as to better align with the current time of day toll rate schedule utilized by the ICC. An automated process was then employed that involved iteratively adjusting the input assignment trip table until assigned volumes match screenline counts within a reasonable range. Lastly, VOT and VOC values were adjusted during the calibration process.

Overall, the model speeds, diversion, traffic volumes, and specific ICC patterns output by the modified model were close to the observed data for FY 2014. Through validation against base year conditions, the network characteristics of the ICC corridor and surrounding area matched existing conditions. Trip length distribution comparisons before and after each Matrix Estimation (ME) step showed no significant change in trip characteristics. In addition, speed comparisons against INRIX speeds showed that the calibrated model replicates existing bottlenecks reasonably well.

Table 5-6
Summary of Speed Calibration by Roadway and Direction

Roadway	Dir	Length (mi.)	Morning (5-6am)					AM Peak (6-9am)					Midday (9am-4pm)					PM Peak (4-7pm)					Evening (7-11pm)				
			Model Data	INRIX Data			Diff From Avg	Model Data	INRIX Data			Diff From Avg	Model Data	INRIX Data			Diff From Avg	Model Data	INRIX Data			Diff From Avg	Model Data	INRIX Data			Diff From Avg
				Avg	Min	Max			Avg	Min	Max			Avg	Min	Max			Avg	Min	Max			Avg	Min	Max	
MD 115	EB	22.1	38	38	37	38	1	33	33	31	36	-1	35	34	32	35	1	32	33	32	34	-1	36	35	34	35	1
MD 115	WB	22.1	39	37	37	37	2	32	34	33	36	-2	35	34	33	35	1	31	33	32	34	-1	36	35	34	36	1
ICC	EB	18.5	64	57	54	60	7	63	64	63	64	-1	63	63	62	65	0	63	64	63	65	-1	63	57	53	61	6
ICC	WB	18.0	64	61	60	62	3	63	64	63	64	-1	63	62	61	64	1	63	62	61	63	1	64	55	52	59	8
MD 28/MD 198	EB	19.4	41	40	40	40	1	32	35	34	38	-3	34	35	33	36	-1	29	33	32	34	-4	37	37	36	38	0
MD 28/MD 198	WB	19.4	40	40	40	41	0	30	34	31	38	-4	34	35	33	36	-1	31	35	34	36	-4	37	38	37	38	-1
Veirs Mill Rd.	EB	8.9	38	36	36	37	2	34	31	29	34	3	34	29	27	31	4	30	28	28	29	2	36	32	31	33	3
Veirs Mill Rd.	WB	8.9	36	36	36	37	0	31	30	27	34	1	33	29	27	30	4	31	29	28	29	2	35	32	30	33	3
Randolph Rd.	EB	16.3	38	35	35	36	2	34	32	31	34	2	33	32	30	32	2	30	30	29	31	0	36	33	32	34	2
Randolph Rd.	WB	16.3	39	36	36	36	3	32	31	28	34	1	34	32	29	33	2	32	31	31	32	1	36	34	33	34	3
I-270	NB	9.1	64	63	63	63	2	61	62	61	63	-1	58	61	58	62	-3	46	46	39	55	0	58	60	56	61	-2
I-270	SB	9.1	60	65	65	66	-6	42	41	33	62	1	55	60	45	63	-4	58	62	61	63	-4	64	62	62	63	1
I-270	EB	2.7	64	65	65	65	-2	42	58	54	64	-16	53	60	50	63	-7	58	50	45	55	8	62	61	59	62	2
I-270	WB	2.7	64	63	63	63	0	46	61	60	63	-15	50	61	57	62	-11	52	40	34	50	12	58	60	58	61	-2
I-495	EB	8.8	63	63	63	63	0	46	58	55	63	-12	39	54	36	60	-14	38	38	34	44	0	50	56	50	59	-6
I-495	WB	6.6	60	63	62	64	-3	31	27	22	55	4	41	51	27	61	-10	45	51	48	54	-6	58	59	56	60	0
I-95	NB	6.7	64	63	62	64	1	49	61	58	63	-11	47	63	55	65	-16	35	49	44	57	-14	51	52	46	63	-1
I-95	SB	6.6	62	64	64	65	-3	55	49	43	64	6	59	63	51	67	-5	55	61	58	64	-5	60	51	50	53	9
I-95/I-495	EB	1.3	63	67	67	67	-4	59	58	51	66	1	59	62	54	66	-3	32	37	29	48	-5	62	62	58	63	0
I-95/I-495	WB	1.6	63	66	66	67	-3	51	37	29	63	14	50	61	45	65	-11	61	59	57	60	2	62	62	61	63	0
US 1	NB	6.9	39	38	38	39	1	36	34	32	36	2	33	31	30	32	2	29	29	28	31	0	36	34	32	35	2
US 1	SB	6.9	38	38	38	38	0	33	34	31	37	-1	34	31	30	32	3	33	30	29	31	3	36	34	32	35	2

Chapter 6

Traffic and Revenue Forecast

The primary objective of this study was to develop up-to-date forecasts of traffic and toll revenue for the ICC. These forecasts were developed based upon detailed review of the historical traffic and toll revenue data for the ICC, existing travel speed conditions, socioeconomic forecast assumptions, and modeling methodology previously described. This chapter summarizes the forecasts of future year transactions and toll revenue for the ICC, which have been prepared by payment type on a weekday and an annual basis through FY 2040. Also included are monthly forecasts for FY 2016 and 2017.

6.1 Basic Assumptions

Transaction and revenue estimates for the ICC were predicated upon the following assumptions, which are considered reasonable by CDM Smith for the purposes of this forecast:

1. The ICC and approach roads will continue to be well maintained and effectively signed;
2. The ICC will continue to operate as currently configured, with no new extensions, interchanges or widenings during the forecast period;
3. No competing highway projects other than those identified in the financially constrained long-range plan will be constructed or significantly improved during the forecast period;
4. MDTA will continue to operate within its business rules and practices;
5. The existing FY 2016 toll collection concept and current toll rates will be in effect throughout the forecast period;
6. Annual revenue estimates are expressed in future-year dollars (nominal);
7. No major recession, natural disasters, local or national emergency, or other significant exogenous events will occur that would abnormally restrict the use of motor vehicles or would significantly reduce travel or mobility in the region;
8. Population and employment growth will occur as presented in this study; and
9. Motor fuel will remain in adequate supply, and future price increases will not significantly exceed the long-term rate of inflation;

6.2 Toll Reduction Analysis

Under the forecast assumptions, only one toll change was assumed during the forecast period and that was the toll decrease implemented on July 1, 2015. Under this decrease, per-mile toll rates on the ICC decreased by $0.03 per mile across all time periods. This resulted in a per-mile toll decrease from $0.25 to $0.22 during the Peak Period, $0.20 to $0.17 during the Off-Peak Period, and $0.10 to $0.07 during the Overnight Period.

In order to assess the impacts of this toll rate decrease and the sensitivity of the traffic response on the ICC system, CDM Smith reviewed actual transaction data provided by MDTA prior to and after the toll decrease. Transaction data by toll gantry from just prior to the toll increase, June 2015, were compared against comparable data from the prior year to estimate the "Normal Growth Rate." Normally, an entire quarter of data would be used (April through June). However, while gas prices in April and May 2014 were relatively stable, they fluctuated significantly enough in 2015 that to include these months in the analysis would water down the impacts of the toll decrease with the impacts of the changes in gas price year-over-year. Transaction data by toll gantry from after the toll increase, July through September 2015, were compared against comparable data from the prior year to estimate the year-over-year change resulting from the combination of "Normal Growth" and the toll rate decrease. Gas price patterns for July through September 2014 exhibited similar patterns to those of July through September 2015, such that all three months could be used without including impacts of the changes in gas price year-over-year in the analysis. By subtracting the estimated normal growth rate from the combined impacts after the toll rate decrease, an estimate of the positive impact to ICC usage from the toll rate decrease was developed by gantry. The resulting estimated impacts of the toll rate decrease for the ICC facility by toll gantry is presented in **Table 6-1**. An estimated elasticity was developed by gantry based on an approximate toll increase of 15 percent, which is an average of all time periods (Peak, Off-Peak and Overnight) for both weekdays (about a 14.8 percent decrease) and weekends (about a 16.5 percent decrease) based on the relative traffic volumes in each period.

It should be noted that holidays and holiday weekends were excluded from this analysis, as the travel patterns for these days tend not to be consistent from year to year due to the fact that the same holiday can fall on a different day each year. A three-day weekend, where the holiday falls on a Friday, has a different set of travel patterns than a two-day weekend with a holiday on a Thursday or Wednesday.

As shown in the table, the estimated average percent impact of the toll rate decrease across the ICC was a 3.7 percent increase in toll transactions. This was roughly the same across all toll gantries, with the exception of the I13/I14 gantries, which are between US 29 and I-95, where the estimated impacts were 4.6 percent. Based on an approximate percent toll rate decrease of 15 percent, the estimated toll elasticity of the ICC is -0.249. This means that for every 10 percent decrease in the toll rate, transactions would increase by roughly 2.5 percent. This is a relatively low elasticity, implying that the toll rates that were in place prior to the toll decrease were in a reasonable and appropriate range and confirming the value being placed by users on the ICC.

Table 6-1
Estimated Impact of July 2015 Toll Decrease and ICC Toll Elasticity

	Toll Gantry Location [1]					
	I01/I02	I05/I06	I07/I08	I09/I10	I13/I14	**Total**
FY 2015 over FY 2014 Growth Rate for June [2]	11.6%	14.0%	14.8%	16.7%	19.8%	**15.2%**
FY 2015 over FY 2014 Growth Rate for July - September [2]	15.0%	17.6%	18.6%	20.2%	24.4%	**18.9%**
Difference	**3.4%**	**3.6%**	**3.8%**	**3.5%**	**4.6%**	**3.7%**
Approximate Percent Toll Decrease	-15.0%	-15.0%	-15.0%	-15.0%	-15.0%	**-15.0%**
Estimated Toll Elasticity	-0.226	-0.239	-0.250	-0.234	-0.307	**-0.249**
Assumed Percent Impact in Traffic and Revenue Forecasts						**3.5%**

[1] The ICC Extension to US 1 opened in Nov. 2014. As a result, Year-over-Year Growth Rates for June through Sept. are unavailable for I17/I18.

[2] Excludes Holidays and Holiday Weekends.

6.3 Toll Sensitivity Analysis

Traffic assignments were performed at multiple toll levels for each analysis year, including FY 2014 and FY 2040. For FY 2014 (our calibration model year), Electronic Toll Collection (ETC), i.e. E-ZPass®, passenger car per-mile toll rates ranging from $0.05 to $0.60 were tested. ETC per-mile toll rates tested at FY 2040 levels ranged from $0.05 to $1.00. From the resulting model assignments, toll sensitivity curves were prepared to evaluate where the current toll rates fall on the toll revenue curve and to determine revenue maximizing toll rates. Separate curves were prepared for each of the six model time periods: AM Peak Period (6:00 – 9:00 AM), PM Peak Period (4:00 – 7:00 PM), Midday Off-Peak Period (9:00 AM – 4:00 PM), Evening Off-Peak Period (7:00 – 11:00 PM), Morning Off-Peak Period (5:00 – 6:00 AM) and Overnight Period (11:00 PM – 5:00 AM).

Toll sensitivity curves for the base year, FY 2014, and future year, FY 2040, are shown in **Figures 6-1 through 6-6**. Each figure shows the estimated toll sensitivity curves for traffic and toll revenue for each of the six model time periods based on the toll rates tested for both ETC and video customers. While the levels shown on the x-axis of the graphs in **Figures 6-1 through 6-6** are expressed in terms of the passenger car per-mile toll rates, proportionately higher rates were assumed to be charged for trucks during the actual toll diversion process. The black dot on each curve represents the estimated traffic or toll revenue at the toll rates prior to the July 1, 2015 toll decrease, and the red dot on each curve represents the estimated traffic or toll revenue at the current toll rates.

As shown in **Figure 6-1**, the maximum revenue potential for ETC customers during both the AM and PM Peak Periods would be in the range of $0.35 per mile at FY 2014 levels. The current per-mile toll rate during both peak periods is $0.22 per mile, which is more than 35 percent less than the estimated "optimum toll rate" of $0.35 per mile. Since video customers, pay 1.5 times the ETC toll rates (with a minimum of $1.00 and a maximum of $15.00 above the base rate), the estimated toll sensitivity curves for video customers place the current video toll rate and the video toll rate prior to the July 1, 2015 toll decrease near or at the top of the toll revenue curve.

Figure 6-2 illustrates the estimated traffic and revenue toll sensitivity curves for two of the three segments of the Off-Peak Period: Midday and Evening. During both of these periods, which represent the majority of the Off-Peak Period, the estimated "optimum toll rate" is in the range of $0.25 to $0.30 per mile. As with the AM and PM Peak Periods, the current per-mile toll rate during the Off-Peak Period is $0.17 per mile, which is more than 35 percent less than the estimated "optimum toll rate." The estimated toll sensitivity curves for video customers would also place the current video toll rate and the video toll rate prior to the July 1, 2015 toll decrease at the top of the toll revenue curve.

Estimated traffic and revenue toll sensitivity curves for the final two time periods, Morning Off-Peak and Overnight, are illustrated in **Figure 6-3**. During the Morning Off-Peak Period, the estimated "optimum toll rate" is in the range of $0.25 to $0.30 per mile. The Morning Off-Peak Period is the only time period in FY 2014 where the current video toll rate and the video toll rate prior to the July 1, 2015 toll would be slightly on the down-side of the estimated toll revenue curve. The reduction in the toll rate on July 1, 2015 has moved that point back to the top of the curve. Also shown in **Figure 6-3** is the Overnight Period, where the estimated "optimum toll rate" is in the range of $0.25 to $0.30 per mile. The current Overnight Period per-mile toll rate of $0.07 per mile is about 75 percent less than the estimated "optimum toll rate."

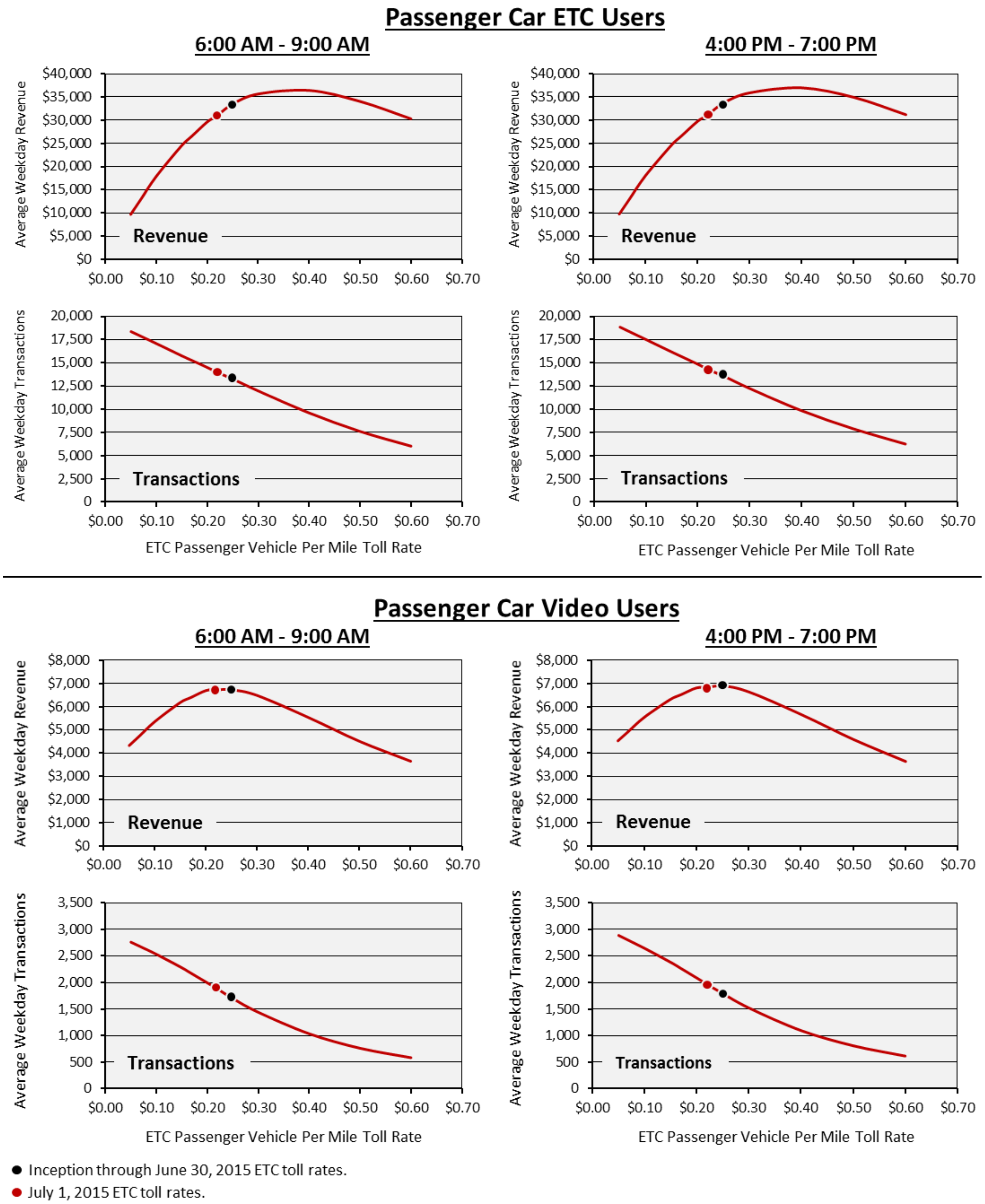


Figure 6-1
FY 2014 Estimated Toll Sensitivity Curves
AM Peak Period (6:00 – 9:00 AM) and PM Peak Period (4:00 – 7:00 PM)

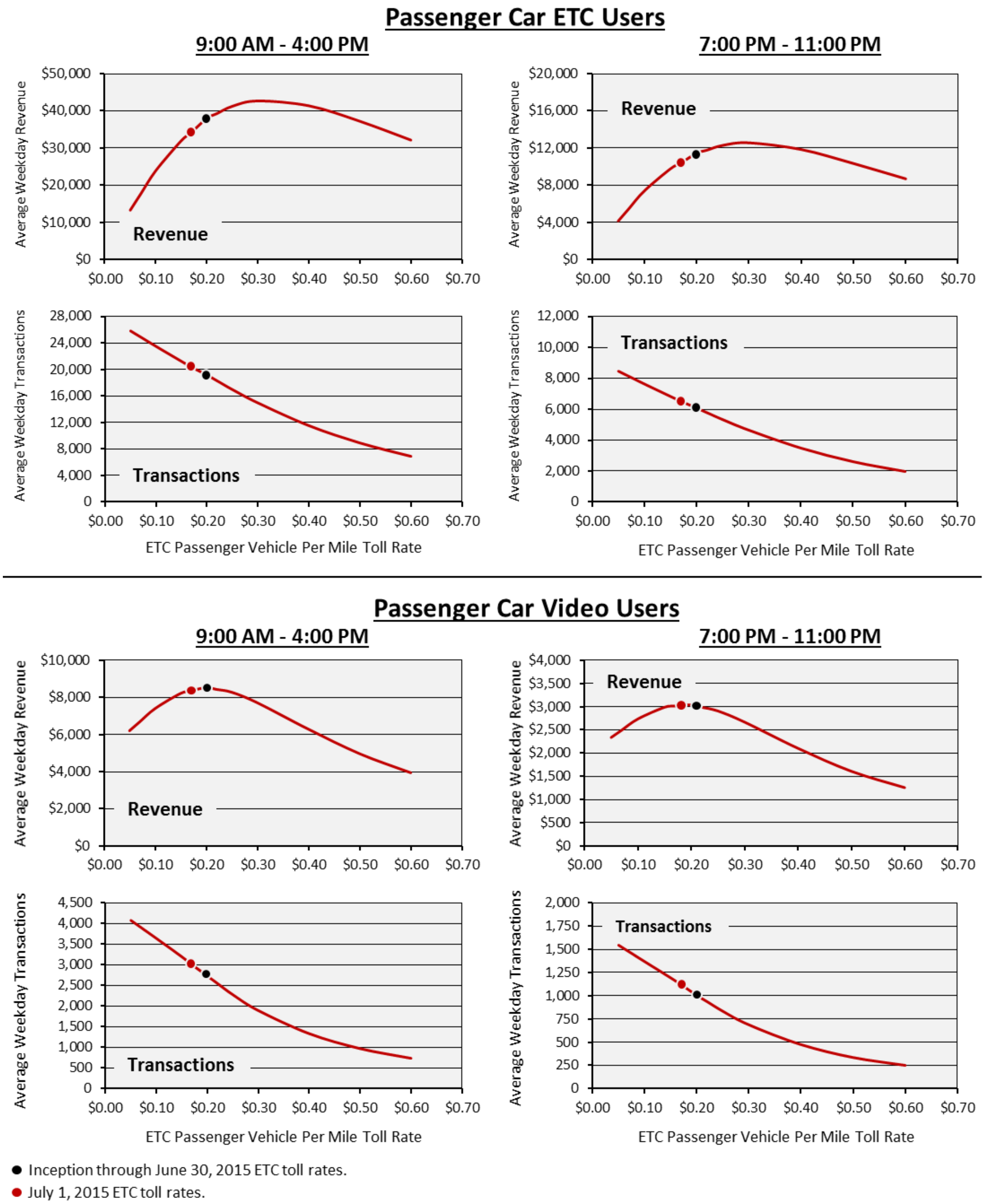


Figure 6-2
FY 2014 Estimated Toll Sensitivity Curves
Midday Off-Peak Period (9:00 AM – 4:00 PM) and Evening Off-Peak Period (7:00 – 11:00 PM)

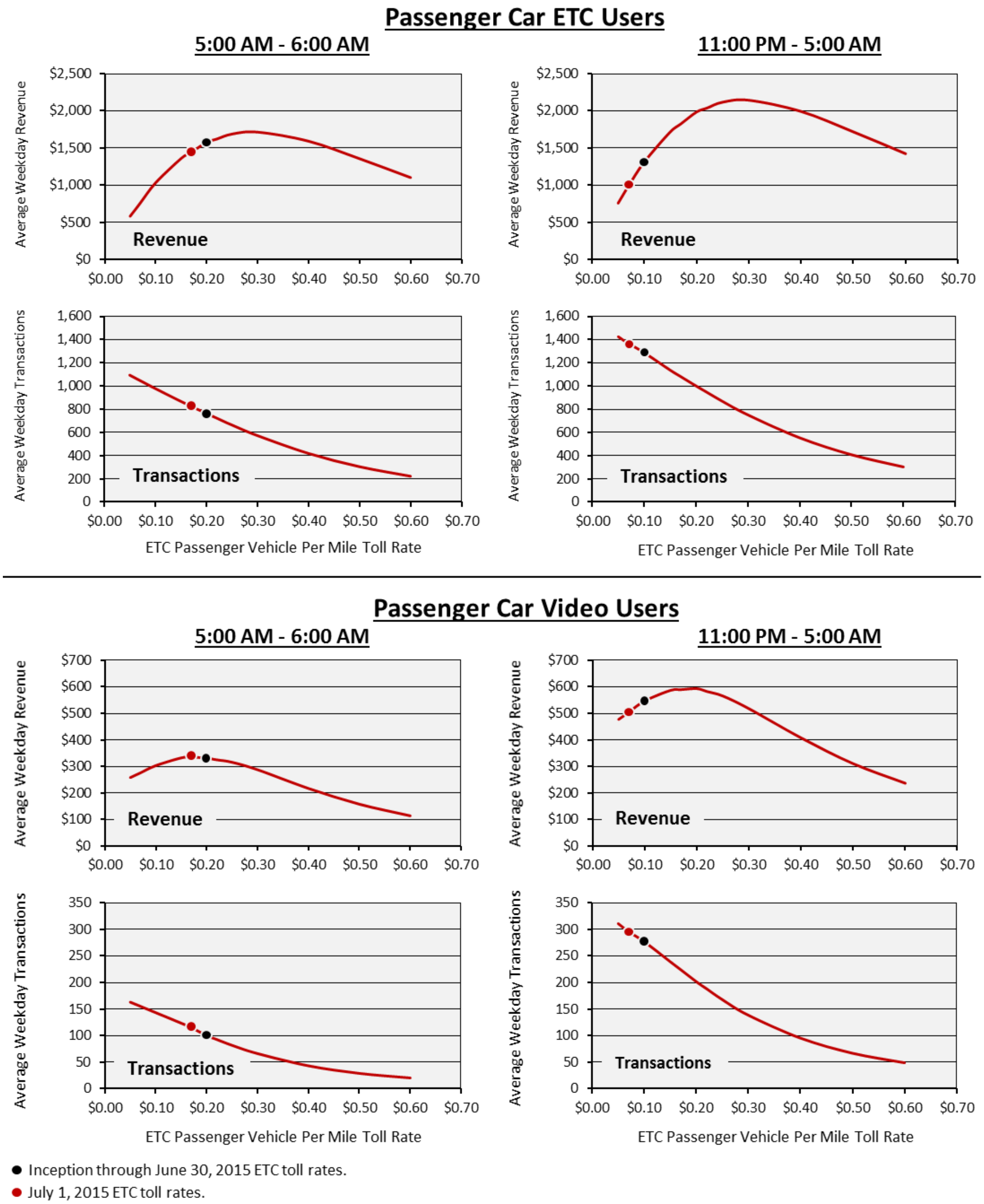


Figure 6-3
FY 2014 Estimated Toll Sensitivity Curves
Morning Off-Peak Period (5:00 – 6:00 AM) and Overnight Period (11:00 PM – 5:00 AM)

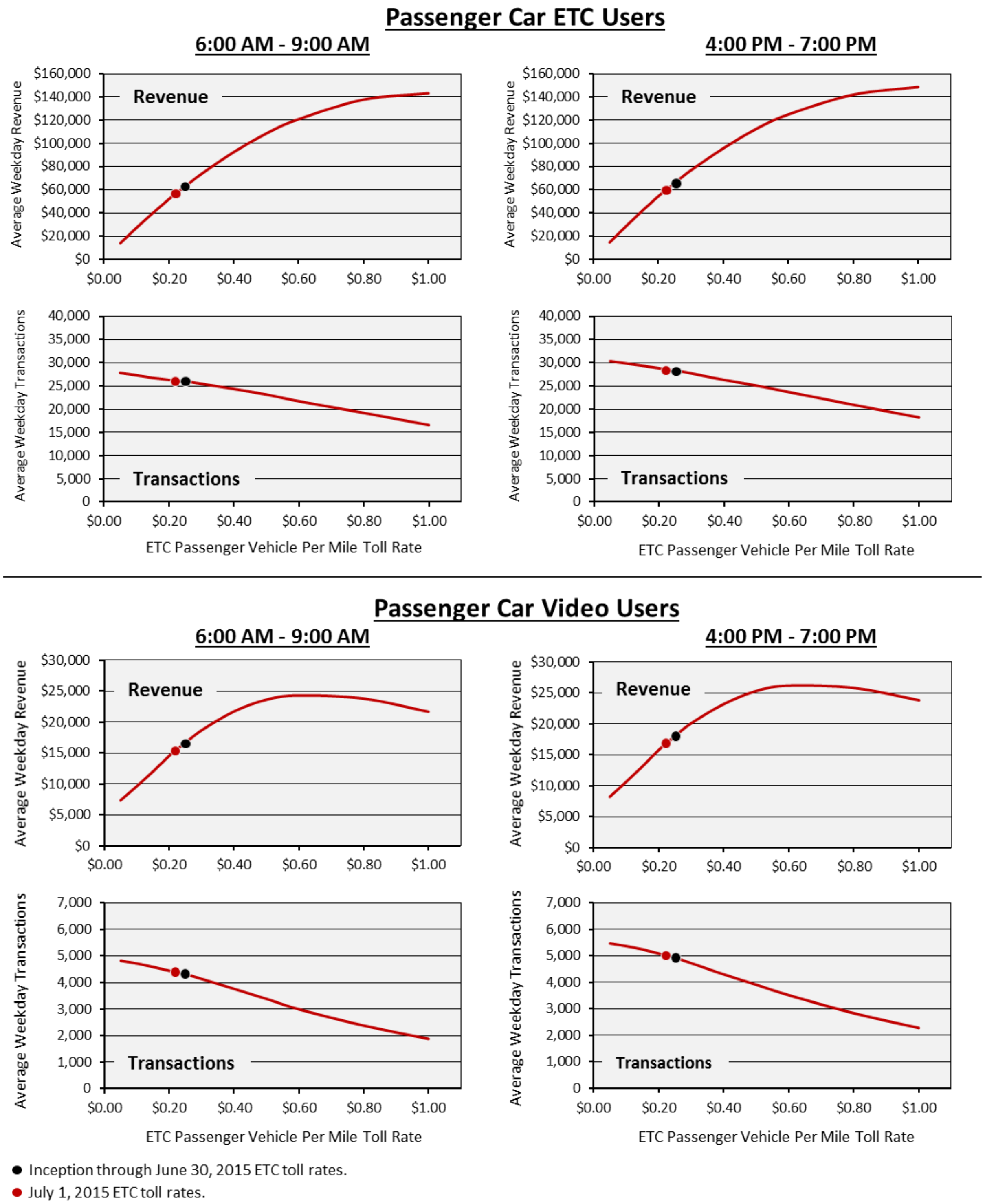


Figure 6-4
FY 2040 Estimated Toll Sensitivity Curves
AM Peak Period (6:00 – 9:00 AM) and PM Peak Period (4:00 – 7:00 PM)

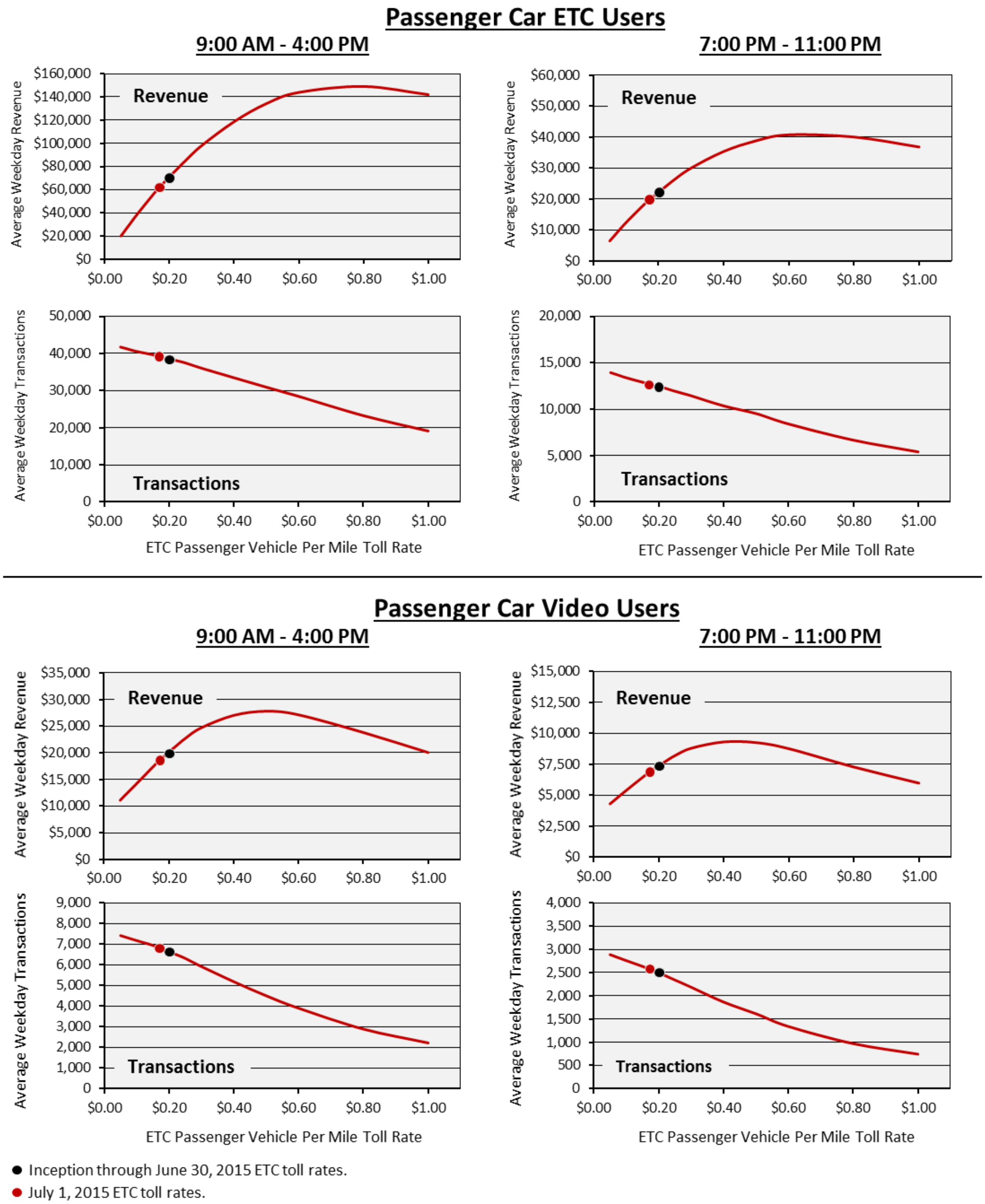


Figure 6-5
FY 2040 Estimated Toll Sensitivity Curves
Midday Off-Peak Period (9:00 AM – 4:00 PM) and Evening Off-Peak Period (7:00 – 11:00 PM)

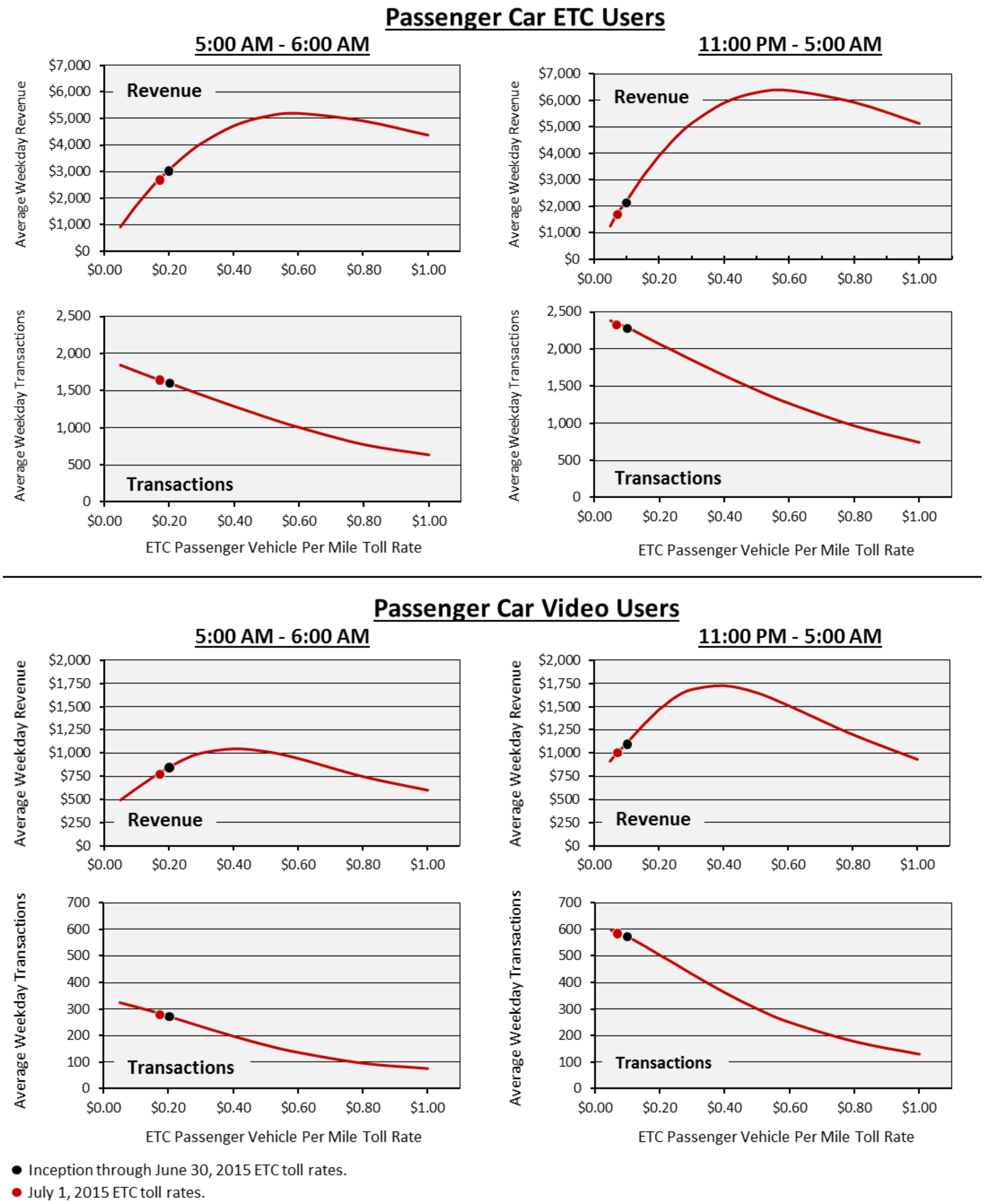


Figure 6-6
FY 2040 Estimated Toll Sensitivity Curves
Morning Off-Peak Period (5:00 – 6:00 AM) and Overnight Period (11:00 PM – 5:00 AM)

Toll sensitivity curves for the future year, FY 2040, are shown in **Figures 6-4 through 6-6** (shown previously) for each of the six model time periods for both ETC and video customers. Based on the estimated traffic and toll revenue for FY 2040 at the various toll rates tested, the current toll rates are significantly further down the estimated toll revenue curve during all time periods as compared to FY 2014. This is because the impacts of increasing Values of Time (VOT) due to inflation and real household income growth, as well as higher traffic congestion on the arterial roadway network have the effect of reducing the cost of toll rates in real terms.

For example, the maximum toll revenue potential for ETC customers during both the AM and PM Peak Periods, as shown in **Figure 6-4** (shown previously), would be in the range of $1.00 per mile at FY 2040 levels. This is more than four times the current peak period per-mile toll rate of $0.22. The traffic and revenue curves for the remaining four time periods in FY 2040, shown in **Figures 6-5 and 6-6** (shown previously), all show a similar shift of the current ETC and video toll rates to a position further down the toll revenue curves.

There are several conclusions that result from the toll sensitivity analysis performed as part of this study. First, these curves and the limited toll reduction analysis in the previous section demonstrate that ICC toll rates have been set in an appropriate range relative to the top of the toll revenue curve. Second, MDTA has room to increase toll rates, at least in line with inflation, in the future if additional toll revenues are needed. Further, additional toll revenues would not be generated by reducing tolls, as the estimated toll sensitivity curves show that the ICC is currently below the “optimum toll rate” during all time periods, with an increasing difference between the current and “optimum toll rate” over time. Lastly, the movement of current video toll rates from a position at the top of the revenue curve to a position on the up-side of the curve implies that MDTA should expect to see continued growth in video customers between FY 2014 and FY 2040. This would occur as their real toll rate continues to decrease while they continue to occupy a more elastic portion of the toll sensitivity curve.

6.4 ICC Traffic Forecast

As noted previously, traffic assignments were run using the MWCOG model, which was modified and calibrated to the ICC corridor for this project by CDM Smith. Traffic assignments were run at FY 2014, FY 2015 (with the assumed opening-year of the Phase 3 Segment of the ICC from I-95 to US 1), FY 2023, FY 2030, and FY 2040 levels.

The assignment results were reviewed for reasonableness, using both select link and screenline corridor share analyses. In the screenline review, special attention was paid to the overall level of growth in traffic throughout the projection period, and the relative share of total screenline demand expected to be accommodated by the ICC.

6.4.1 Estimated Average Weekday Traffic Volumes

Annual average weekday traffic (AAWDT) volumes for the ICC are presented in **Figure 6-7** for forecast years FY 2023, FY 2030 and FY 2040. The estimates incorporate all of the analyses and assumptions utilized in this study and described in this report. The estimated traffic volumes do not assume any toll rate increases or decreases over the forecast period. They do however reflect the toll structure that was put in place on July 1, 2015.

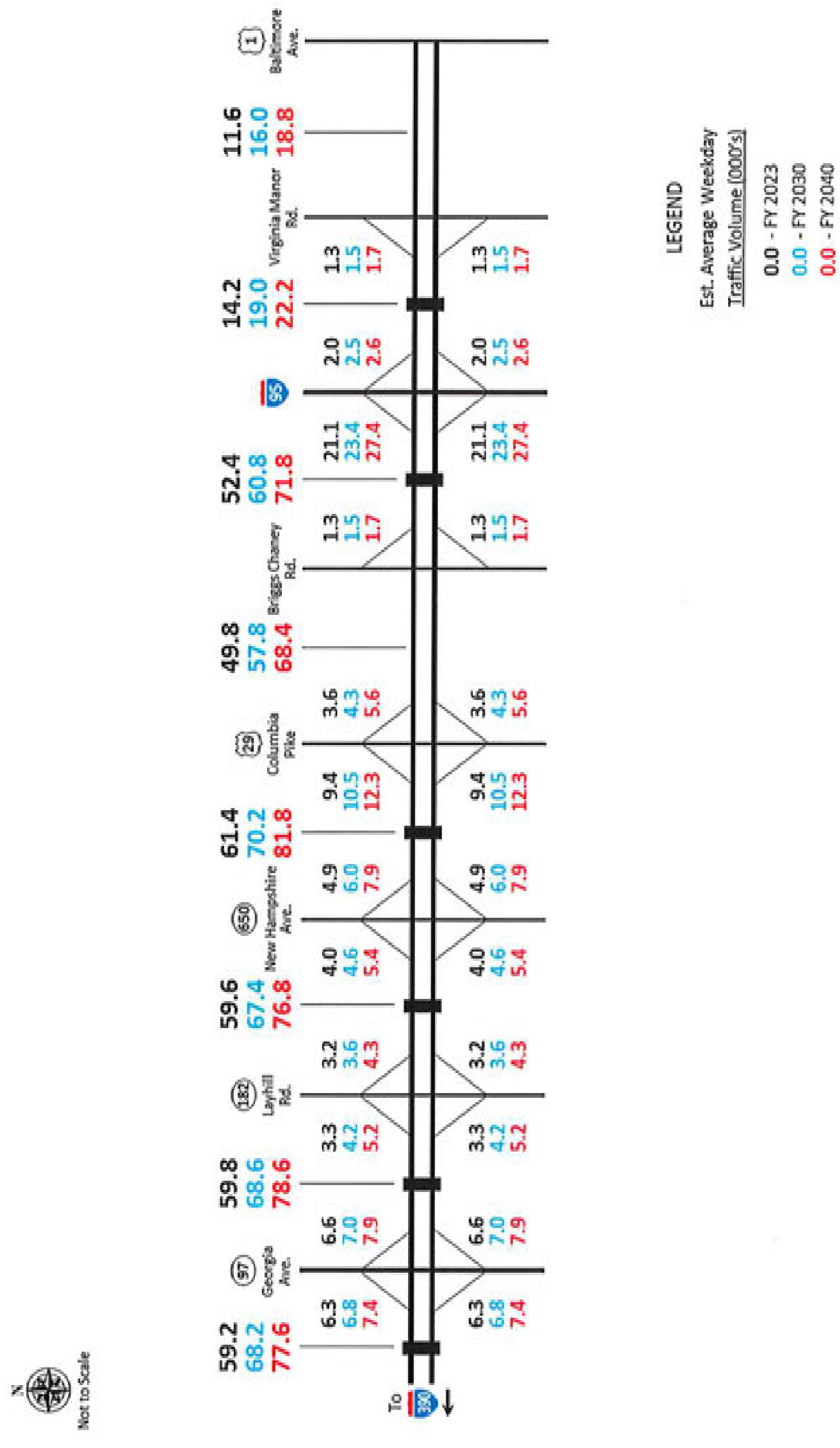


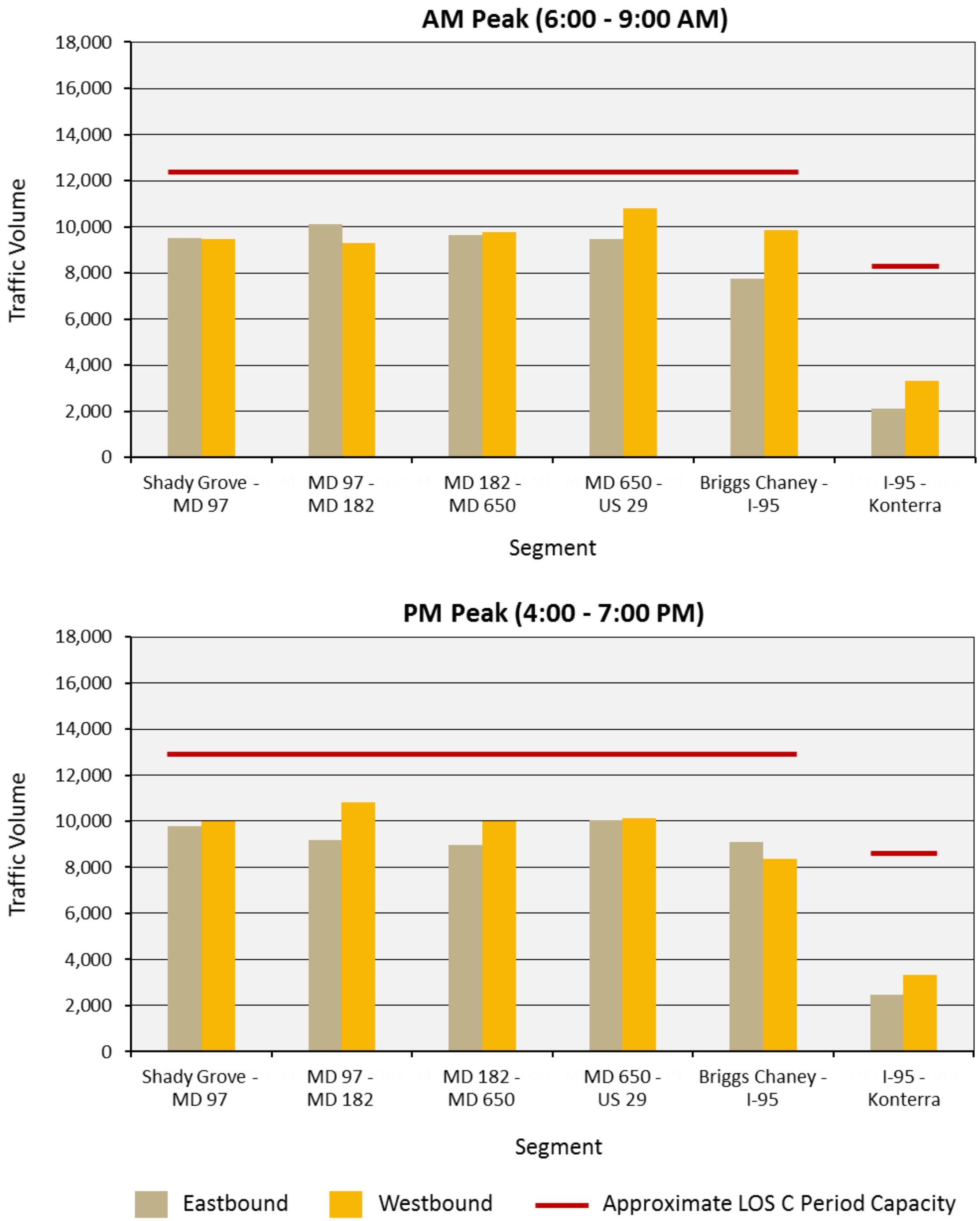
Figure 6-7
Estimated Average Weekday Traffic Volumes on the Intercounty Connector

Table 6-2
Average Annual Weekday Interchange-to-Interchange Movements, FY 2023 – FY 2040

		MD 97 / Georgia Ave.	MD 182 / Layhill Rd.	MD 650 / New Hampshire Ave.	US 29	I-95	US 1 and Konterra Dr.	**Total**
I-370; Shady Grove Rd.	FY 2023	12,600	5,200	5,600	11,100	20,700	4,000	**59,200**
	FY 2030	13,600	6,900	6,700	12,400	22,800	5,800	**68,200**
	FY 2040	14,800	8,500	8,000	14,200	25,100	7,000	**77,600**
MD 97 / Georgia Ave.	FY 2023		1,400	1,700	3,000	5,900	1,200	**13,200**
	FY 2030		1,500	1,700	3,100	6,100	1,600	**14,000**
	FY 2040		1,900	1,900	3,600	6,600	1,800	**15,800**
MD 182 / Layhill Rd.	FY 2023			700	1,700	3,100	900	**6,400**
	FY 2030			800	1,900	3,500	1,000	**7,200**
	FY 2040			900	2,300	4,100	1,300	**8,600**
MD 650 / New Hampshire Ave.	FY 2023				3,000	5,000	1,800	**9,800**
	FY 2030				3,600	6,100	2,300	**12,000**
	FY 2040				4,500	8,400	2,900	**15,800**
US 29 and Briggs Cheney Rd.	FY 2023					7,500	2,300	**9,800**
	FY 2030					8,300	3,300	**11,600**
	FY 2040					10,600	4,000	**14,600**
I-95	FY 2023						4,000	**4,000**
	FY 2030						5,000	**5,000**
	FY 2040						5,200	**5,200**
Total	**FY 2023**	**12,600**	**6,600**	**8,000**	**18,800**	**42,200**	**14,200**	**102,400**
	FY 2030	**13,600**	**8,400**	**9,200**	**21,000**	**46,800**	**19,000**	**118,000**
	FY 2040	**14,800**	**10,400**	**10,800**	**24,600**	**54,800**	**22,200**	**137,600**

6.4.3 Peak Period Segment Volumes and Capacity

One consideration for the future-year traffic volumes was whether or not travel demand would exceed a theoretical "Level of Service C" capacity on any segment of the ICC. Although MDTA has not determined what Level of Service threshold might trigger congestion-managed toll increases, for the purposes of this analysis it is assumed that "Level of Service C" represented that threshold. **Figure 6-8** illustrates the relationship between the theoretical "Level of Service C" Peak Period capacity and the estimated FY 2040 volumes during the AM Peak (6:00 – 9:00 AM) and PM Peak (4:00 – 7:00 PM) Periods on the ICC by segment and direction. As is shown in the figure, FY 2040 estimated average Peak Period volumes on the ICC range between 8,000 and 10,000 vehicles during both the AM and PM Peak Periods west of I-95. This is roughly 2,500 vehicles less than the theoretical "Level of Service C" capacity for these segments. Similarly, the new ICC Extension to US 1 is estimated to carry between 2,000 and 4,000 vehicles during both the AM and PM Peak Periods, which is more than 4,000 vehicles less than the theoretical "Level of Service C" capacity. Based on this analysis, no toll increases would be required to maintain "Level of Service C" travel conditions through the forecast period. This analysis is based on estimated annual average daily traffic volumes. While specific hourly traffic volumes will vary by day and time of year, average traffic volumes on the ICC are estimated to be less than the estimated "Level of Service C," as noted above.



Note: Although MDTA has not determined what Level of Service threshold might trigger congestion managed toll increases, for purposes of this analysis, it is assumed that "Level of Service C" would not be exceeded.

Figure 6-8
FY 2040 Estimated AM and PM Period Segment Volumes
by Mainline Segment and Direction

6.4.4 Estimated Future ICC Market Share

In reviewing the overall reasonableness of the AAWDT estimates, an analysis was made of the share of total market demand which is expected to be accommodated by the ICC facility. As discussed previously in **Chapter 2**, a series of traffic screenlines were developed to examine the share of the project corridor that would be expected to patronize the ICC and its competing routes. Market share is defined as the amount of traffic utilizing each of the various routes within a specific screenline, including the proposed facility, as a proportion of the total screenline value. CDM Smith utilized the screenlines developed previously as shown in **Figure 6-9**, which include the ICC, I-495, and all other routes passing through the screenlines.

The results of the market share analysis at FY 2014 and future-year levels for the ICC are provided in **Table 6-3**. In FY 2014, the ICC market share ranged between 7.2 and 9.3 percent of east-west traffic in the study area. Since the extension to US 1 opened in November 2014 (FY 2015), no market share is estimated for the ICC on Screenline 7 in FY 2014.

By FY 2023, ICC market share is estimated to increase to between 10.3 and 11.9 percent, an increase of roughly 3 percent. This is mainly due to the double digit growth experienced on the ICC during FY 2015 and forecasted for FY 2016, which captures a significant amount of the average 1.0 percent per year screenline traffic growth. The additional traffic pulled onto the ICC as a result of the toll reduction also contributes to the higher growth for the ICC.

Average screenline growth between FY 2023 and FY 2030 is estimated to average roughly 0.5 percent per year. The ICC, by contrast, is estimated to grow an average of 2.0 percent (excluding the ICC extension to US 1). Traffic on the ICC Extension to US 1 is estimated to grow by an average of 4.3 percent per year as a result of the continued economic developments assumed in this area, as well as the fact that it is starting from a much lower volume in general. Average traffic growth on the ICC is estimated to exceed average screenline growth for three main reasons: increasing congestion on the arterial network, development focused around the ICC corridor, and the impact of inflation on the constant toll rate, effectively lowering the toll in real dollars and making the value proposition of the ICC more attractive. The estimated market share for the ICC is estimated to increase to between 11.5 and 13.2 percent of east-west traffic in the study area.

Between FY 2030 and FY 2040, screenline traffic growth is estimated to grow at an average annual rate of roughly 0.45 percent per year. For the same reasons discussed previously, the ICC is estimated to exceed screenline traffic growth with an average annual percent change of roughly 1.4 percent (excluding the ICC extension to US 1). Traffic on the ICC extension to US 1 is estimated to grow by an average of 1.6 percent per year, coming more in line with the remainder of the facility. The higher growth rates on the ICC as compared to the more mature facilities again results in an increase in the estimated market share for the ICC to between 12.5 and 14.5 percent of east-west traffic in the study area.

6.5 ICC Trip and Revenue Forecast

CDM Smith developed the forecasts of ICC trips and toll revenue from the results of the interchange-to-interchange movements from the ICC traffic assignments, described previously. The assignments were conducted on an AAWDT basis, from which an estimate of trips and toll revenue for the average weekday were developed. From this, a forecast of annual ICC trips and toll revenue and a short-term monthly forecast of ICC trips and toll revenue were also developed using annualization factors and monthly factors based on historical ICC data, as described in greater detail in this section.

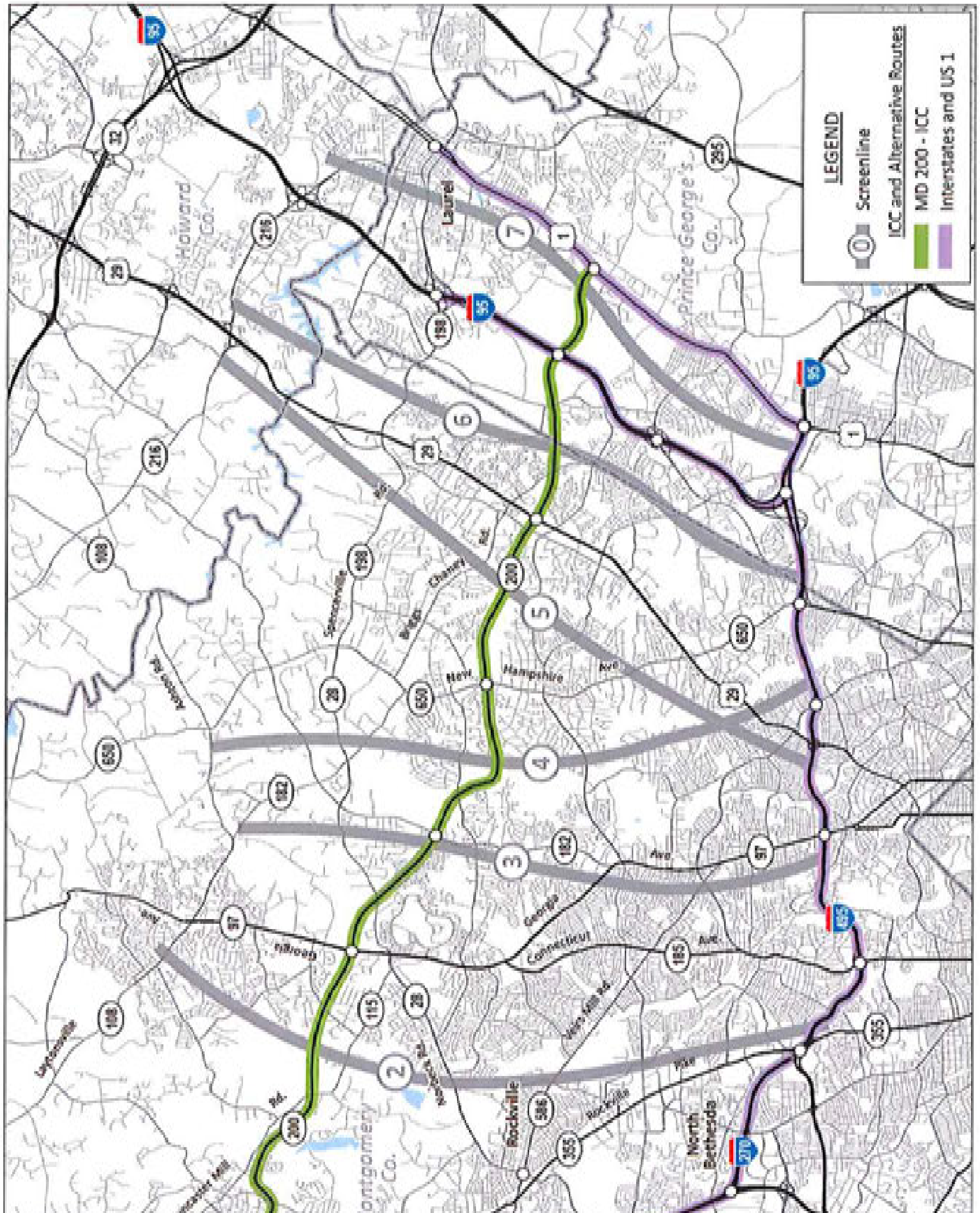


Figure 6-9
Intercounty Connector and Alternative Routes with Selected Screenlines

6.5.1 Weekday Trips and Toll Revenue by Time Period

Estimates of average weekday trips and toll revenue under FY 2023, FY 2030 and FY 2040 conditions are presented by time period in **Table 6-4**. Average weekday trips are arrayed by method of payment. Information regarding average tolls are also provided under both modes of payment. Estimates of average weekday trips and revenue are presented in **Table 6-4** and, as discussed below, have not been adjusted to reflect revenue impacts due to leakage, including unpaid transactions. Revenues collected will be lower than shown due to leakage.

As shown in **Table 6-4**, the ICC is estimated to produce a total of 102,400 tolled trips on an average weekday in FY 2023. Of this sum, 88,600 trips would be generated by ETC customers and 13,800 trips by video customers (86.5 and 13.5 percent, respectively). These average weekday trip levels would produce an estimated $231,400 in average weekday toll revenues. In FY 2030, average weekday total trips are estimated to increase to 118,000. ETC trips are estimated to comprise 101,500 of these trips and video trips are estimated to comprise 16,500 trips (86.0 and 14.0 percent, respectively). Total toll revenues of $269,000 are expected to be generated based on these transaction levels. Average weekday trips are estimated to increase to 137,600 tolled trips in FY 2040. 117,300 trips are estimated to be generated by ETC customers and 20,300 trips by video customers (85.2 and 14.8 percent, respectively). These average weekday trip levels would produce an estimated $313,000 in average weekday toll revenues.

These estimated trips and toll revenues would produce average tolls ranging between $2.53 and $2.54 during Peak Periods, $2.05 and $2.07 during Off-Peak Periods, and $1.04 and $1.06 during Overnight Periods. An indication of average trip length for each of these periods was estimated by dividing the average ETC toll by the per-mile toll rate for each respective period. Average trip lengths through the forecast period were calculated to be approximately 10.8 miles during the Peak Period, 11.3 miles during the Off-Peak Period and 12.9 miles during the Overnight Period.

Additionally, average tolls range between $2.11 and $2.13 for ETC customers and $3.18 and $3.21 for video customers. The average video toll is roughly 50 percent higher than the ETC toll, which is consistent with the tolling surcharge assessed to a video user. This indicates a similar average trip length for both payment types of roughly 11 miles.

Table 6-4
Estimated Average Annual Weekday Trips and Toll Revenue, FY 2023 – FY 2040

			ETC			Video			Total		
Fiscal Year	**Time Period (1)**	**Per Mile Toll Rate**	Weekday Trips	Average Toll	Weekday Toll Revenue (2)	Weekday Trips	Average Toll	Weekday Toll Revenue (2)	Weekday Trips	Average Toll	Weekday Toll Revenue (2)
2023	Peak	$0.22	43,500	$ 2.37	102,900	6,400	$ 3.64	23,300	49,900	$ 2.53	$ 126,200
	Off-Peak	$0.17	43,000	$ 1.92	82,500	6,900	$ 2.90	20,000	49,900	$ 2.05	$ 102,500
	Overnight	$0.07	2,100	$ 0.90	1,900	500	$ 1.60	800	2,600	$ 1.04	$ 2,700
	Total		**88,600**	**$ 2.11**	**187,300**	**13,800**	**$ 3.20**	**44,100**	**102,400**	**$ 2.26**	**$ 231,400**
2030	Peak	$0.22	50,300	$ 2.38	119,700	7,900	$ 3.58	28,300	58,200	$ 2.54	$ 148,000
	Off-Peak	$0.17	48,900	$ 1.93	94,400	8,100	$ 2.93	23,700	57,000	$ 2.07	$ 118,100
	Overnight	$0.07	2,300	$ 0.87	2,000	500	$ 1.80	900	2,800	$ 1.04	$ 2,900
	Total		**101,500**	**$ 2.13**	**216,100**	**16,500**	**$ 3.21**	**52,900**	**118,000**	**$ 2.28**	**$ 269,000**
2040	Peak	$0.22	57,600	$ 2.36	136,100	9,700	$ 3.53	34,200	67,300	$ 2.53	$ 170,300
	Off-Peak	$0.17	57,200	$ 1.92	110,100	10,000	$ 2.93	29,300	67,200	$ 2.07	$ 139,400
	Overnight	$0.07	2,500	$ 0.88	2,200	600	$ 1.83	1,100	3,100	$ 1.06	$ 3,300
	Total		**117,300**	**$ 2.12**	**248,400**	**20,300**	**$ 3.18**	**64,600**	**137,600**	**$ 2.27**	**$ 313,000**

(1) Peak Period (6:00 - 9:00 AM, 4:00 - 7:00 PM), Off-Peak Period (5:00 - 6:00 AM, 9:00 AM - 4:00 PM, 7:00 - 11:00 PM), Overnight Period (11:00 PM - 5:00 AM).
(2) Does not include revenue impacts due to leakage, including unpaid transactions. Actual collected revenues will be less than shown due to leakage.

6.5.2 Annual Trips and Toll Revenue Forecast

CDM Smith annualized the weekday trips and toll revenue for each of the model years based on annualization factors developed from actual FY 2014 data. This was done for trips and toll revenue by method of payment. For example, one year of trips on the ICC was equivalent in FY 2014 to 329 weekdays for ETC customers and 275 weekdays for video customers.

Estimates of annual toll revenue for the ICC through FY 2040 are presented in **Table 6-5**. Actual data between FY 2011 and FY 2015 are also provided for comparative purposes. The FY 2016 estimates incorporate the observed impacts of the July 1, 2015 toll rate decrease estimated based on data through September 2015. These impacts are carried forward through the forecast period. Short-term annual trip and toll revenue forecasts are based on a review of historical trends and growth rates estimated through the modeling process. Interim year trip and toll revenue forecasts were then developed through interpolation between the model years. **Table 6-5** provides estimates of collected toll revenue, which represents revenue that is estimated to be actually collected by MDTA after assumed reductions due to unbillable and unpaid transactions and other revenue leakage issues. Leakage rates were assumed to be constant throughout the forecast period, with 98.5 percent of ETC toll revenue collected and 76.2 percent of video toll revenue collected.

Short-term annual trip and collected toll revenue forecasts are based on a review of historical trends and growth rates estimated through the modeling process between FY 2015 and FY 2023. A 14.0 percent increase in trips to 27.5 million and a 1.6 percent increase in collected toll revenues to $56.9 million is estimated for the first forecast year, FY 2016, as compared to FY 2015. These increases in trips and toll revenue are impacted by the July 1, 2015 toll rate decrease. CDM Smith estimates that "normal growth" in trips, excluding the toll rate decrease, would produce a 10.2 percent increase in trips and a 10.5 percent increase in toll revenue. This indicates that the toll rate decrease is estimated to produce a 3.8 percent increase in trips and an estimated 8.9 percent decrease in toll revenue. Trips in FY 2017 are estimated to increase by 5.0 percent over FY 2016 to 28.8 million. Collected toll revenues in FY 2017 are estimated to increase by 5.3 percent over FY 2016 to $59.9 million.

By FY 2023, annual total trips are estimated to reach more than 33.0 million trips per year, representing an average annual increase of 2.6 percent over FY 2016. These trips produce $69.5 million in annual toll revenue, after including the impacts of leakage. FY 2030 annual trips are then expected to increase by an average of 2.0 percent per year to 67.8 million. This is estimated to generate annual collected toll revenue of $80.7 million. Increasing at an average annual rate of 1.5 percent between FY 2030 and FY 2040, annual toll trips are expected to reach 77.9 million by FY 2040. This translates to $93.8 million in annual collected toll revenue.

6.5.3 Monthly Trips and Toll Revenue Forecast

Based on the annual estimates of trips and toll revenue provided in the previous section, CDM Smith used the FY 2014 monthly distribution of trips to estimate monthly trips and toll revenue for FY 2016 and FY 2017. The estimates of monthly trips and toll revenue for the ICC for all months of FY 2016 and FY 2017 are presented in **Table 6-6**. As noted above, the FY 2016 estimates incorporate the observed impacts of the July 1, 2015 toll rate decrease based on actual data through September 2015. These impacts are carried forward through the forecast period. Leakage rates were assumed to be constant throughout the forecast period, with 98.5 percent of ETC toll revenue collected and 76.2 percent of video toll revenue collected.

Table 6-5
Estimated Annual Trips and Toll Revenue

Fiscal Year	Peak / Off Peak / Overnight Per Mile Toll Rate	Estimated Annual Trips (000s)							Estimated Collected Revenue ($000s) [1]								
		ETC			Video		Total		ETC			Video			Total		
		Trips	AAPC [2]	Percent ETC	Trips	AAPC [2]	Trips	AAPC [2]	Toll Revenue	Percent Collected [3]	Average Toll	Toll Revenue	Percent Collected [3]	Average Toll	Toll Revenue	Percent Collected [3]	Average Toll
2011 [4]	$0.25 / $0.20 / $0.10	1,639		74.7	554		2,193		$ 1,434	98.5	$ 0.87	$ 40	76.2	$ 0.07	$ 1,474	97.7	$ 0.67
2012 [4]	$0.25 / $0.20 / $0.10	9,413	474.3	93.7	630	13.7	10,043	358.0	18,062	98.5	1.92	1,671	76.2	2.65	19,733	96.1	1.96
2013 [4]	$0.25 / $0.20 / $0.10	15,683	66.6	91.2	1,515	140.5	17,198	71.2	34,696	98.5	2.21	4,891	76.2	3.23	39,587	95.1	2.30
2014 [4]	$0.25 / $0.20 / $0.10	18,356	17.0	89.6	2,120	39.9	20,476	19.1	40,924	98.5	2.23	7,104	76.2	3.35	48,028	94.4	2.35
2015 [4]	$0.25 / $0.20 / $0.10	21,598	17.7	89.6	2,520	18.9	24,118	17.8	47,705	98.5	2.21	8,313	76.2	3.30	56,018	94.4	2.32
2016 [5]	$0.22 / $0.17 / $0.07	24,534	13.6	89.2	2,971	17.9	27,505	14.0	47,985	98.5	1.96	8,926	76.2	3.00	56,911	94.2	2.07
2017	$0.22 / $0.17 / $0.07	25,727	4.9	89.1	3,148	6.0	28,875	5.0	50,408	98.5	1.96	9,486	76.2	3.01	59,894	94.1	2.07
2018	$0.22 / $0.17 / $0.07	26,360	2.5	89.0	3,260	3.6	29,620	2.6	51,741	98.5	1.96	9,849	76.2	3.02	61,590	94.1	2.08
2019	$0.22 / $0.17 / $0.07	26,906	2.1	88.9	3,363	3.2	30,269	2.2	52,910	98.5	1.97	10,188	76.2	3.03	63,098	94.1	2.08
2020	$0.22 / $0.17 / $0.07	27,464	2.1	88.8	3,469	3.2	30,933	2.2	54,104	98.5	1.97	10,538	76.2	3.04	64,642	94.0	2.09
2021	$0.22 / $0.17 / $0.07	28,034	2.1	88.7	3,578	3.1	31,612	2.2	55,325	98.5	1.97	10,901	76.2	3.05	66,226	94.0	2.09
2022	$0.22 / $0.17 / $0.07	28,615	2.1	88.6	3,691	3.2	32,306	2.2	56,574	98.5	1.98	11,276	76.2	3.05	67,850	93.9	2.10
2023	$0.22 / $0.17 / $0.07	29,208	2.1	88.5	3,807	3.1	33,015	2.2	57,851	98.5	1.98	11,664	76.2	3.06	69,515	93.9	2.11
2024	$0.22 / $0.17 / $0.07	29,768	1.9	88.4	3,903	2.5	33,671	2.0	59,047	98.5	1.98	11,970	76.2	3.07	71,017	93.9	2.11
2025	$0.22 / $0.17 / $0.07	30,339	1.9	88.3	4,001	2.5	34,340	2.0	60,268	98.5	1.99	12,285	76.2	3.07	72,553	93.8	2.11
2026	$0.22 / $0.17 / $0.07	30,921	1.9	88.3	4,101	2.5	35,022	2.0	61,513	98.5	1.99	12,608	76.2	3.07	74,121	93.8	2.12
2027	$0.22 / $0.17 / $0.07	31,514	1.9	88.2	4,204	2.5	35,718	2.0	62,785	98.5	1.99	12,940	76.2	3.08	75,725	93.8	2.12
2028	$0.22 / $0.17 / $0.07	32,119	1.9	88.2	4,309	2.5	36,428	2.0	64,082	98.5	2.00	13,280	76.2	3.08	77,362	93.8	2.12
2029	$0.22 / $0.17 / $0.07	32,735	1.9	88.1	4,417	2.5	37,152	2.0	65,407	98.5	2.00	13,629	76.2	3.09	79,036	93.8	2.13
2030	$0.22 / $0.17 / $0.07	33,363	1.9	88.1	4,527	2.5	37,890	2.0	66,759	98.5	2.00	13,987	76.2	3.09	80,746	93.7	2.13
2031	$0.22 / $0.17 / $0.07	33,850	1.5	88.0	4,622	2.1	38,472	1.5	67,698	98.5	2.00	14,269	76.2	3.09	81,967	93.7	2.13
2032	$0.22 / $0.17 / $0.07	34,345	1.5	87.9	4,718	2.1	39,063	1.5	68,650	98.5	2.00	14,557	76.2	3.09	83,207	93.7	2.13
2033	$0.22 / $0.17 / $0.07	34,847	1.5	87.9	4,817	2.1	39,664	1.5	69,616	98.5	2.00	14,851	76.2	3.08	84,467	93.7	2.13
2034	$0.22 / $0.17 / $0.07	35,356	1.5	87.8	4,917	2.1	40,273	1.5	70,596	98.5	2.00	15,150	76.2	3.08	85,746	93.7	2.13
2035	$0.22 / $0.17 / $0.07	35,873	1.5	87.7	5,020	2.1	40,893	1.5	71,589	98.5	2.00	15,456	76.2	3.08	87,045	93.6	2.13
2036	$0.22 / $0.17 / $0.07	36,398	1.5	87.7	5,125	2.1	41,523	1.5	72,596	98.5	1.99	15,767	76.2	3.08	88,363	93.6	2.13
2037	$0.22 / $0.17 / $0.07	36,929	1.5	87.6	5,232	2.1	42,161	1.5	73,617	98.5	1.99	16,085	76.2	3.07	89,702	93.6	2.13
2038	$0.22 / $0.17 / $0.07	37,469	1.5	87.5	5,341	2.1	42,810	1.5	74,653	98.5	1.99	16,410	76.2	3.07	91,063	93.6	2.13
2039	$0.22 / $0.17 / $0.07	38,017	1.5	87.5	5,452	2.1	43,469	1.5	75,703	98.5	1.99	16,741	76.2	3.07	92,444	93.5	2.13
2040	$0.22 / $0.17 / $0.07	38,573	1.5	87.4	5,566	2.1	44,139	1.5	76,768	98.5	1.99	17,079	76.2	3.07	93,847	93.5	2.13

(1) Includes revenue impacts due to leakage, including unpaid transactions.
(2) Average Annual Percent Change.
(3) Percent of Gross Toll Revenue collected after including revenue impacts due to leakage.
(4) Actual, also indicated with blue shading.
(5) FY 2016 full year estimates incorporate actual data through September 2015.

Table 6-6
Estimated Monthly Trips and Toll Revenue, FY 2016 – FY 2017

	FY 2016									
	Estimated Trips					Estimated Collected Toll Revenue [1]				
Month	PC ETC	CV ETC	PC Video	CV Video	Total	PC ETC	CV ETC	PC Video	CV Video	Total
Jul	1,945,100	102,800	257,400	6,200	**2,311,500**	$ 3,353,800	$ 691,700	$ 738,800	$ 52,100	**$ 4,836,400**
Aug	1,898,800	96,600	251,300	5,700	**2,252,400**	3,274,000	650,400	721,400	47,600	**4,693,400**
Sep	1,972,400	98,800	247,600	5,800	**2,324,600**	3,400,900	665,100	710,600	48,400	**4,825,000**
Oct	2,036,600	98,500	250,300	5,900	**2,391,300**	3,504,000	670,700	719,300	48,700	**4,942,700**
Nov	1,907,300	87,100	231,500	5,200	**2,231,100**	3,281,500	593,000	665,000	43,000	**4,582,500**
Dec	1,894,900	91,100	230,100	6,500	**2,222,600**	3,260,300	620,500	661,200	53,500	**4,595,500**
Jan	1,714,100	82,100	199,300	6,000	**2,001,500**	2,949,200	559,300	572,500	49,100	**4,130,100**
Feb	1,736,900	80,600	196,700	5,400	**2,019,600**	2,988,300	549,100	565,100	44,600	**4,147,100**
Mar	2,033,500	93,700	238,900	6,100	**2,372,200**	3,498,700	638,100	686,500	49,800	**4,873,100**
Apr	2,026,700	96,300	243,500	6,200	**2,372,700**	3,487,000	655,800	699,700	51,000	**4,893,500**
May	2,142,500	103,700	276,000	7,100	**2,529,300**	3,686,300	706,300	793,100	58,300	**5,244,000**
Jun	2,090,900	103,300	275,400	6,800	**2,476,400**	3,597,400	703,500	791,300	55,900	**5,148,100**
Total	**23,399,700**	**1,134,600**	**2,898,000**	**72,900**	**27,505,200**	**$ 40,281,400**	**$ 7,703,500**	**$ 8,324,500**	**$ 602,000**	**$ 56,911,400**

	FY 2017									
	Estimated Trips					Estimated Collected Toll Revenue [1]				
Month	PC ETC	CV ETC	PC Video	CV Video	Total	PC ETC	CV ETC	PC Video	CV Video	Total
Jul	2,027,400	104,300	280,600	6,600	**2,418,900**	$ 3,496,900	$ 699,000	$ 807,000	$ 55,100	**$ 5,058,000**
Aug	2,092,800	111,600	276,300	6,800	**2,487,500**	3,609,600	747,300	794,700	56,700	**5,208,300**
Sep	2,103,300	106,900	268,000	6,500	**2,484,700**	3,627,800	715,800	770,800	54,000	**5,168,400**
Oct	2,129,300	102,900	267,500	6,300	**2,506,000**	3,672,500	689,000	769,400	52,900	**5,183,800**
Nov	2,048,200	97,200	248,800	5,900	**2,400,100**	3,532,600	650,900	715,400	49,500	**4,948,400**
Dec	1,964,100	94,800	242,600	6,800	**2,308,300**	3,387,700	634,800	697,700	57,100	**4,777,300**
Jan	1,827,200	90,800	211,800	6,600	**2,136,400**	3,151,500	608,500	609,200	55,000	**4,424,200**
Feb	1,737,800	82,400	198,700	5,600	**2,024,500**	2,997,300	552,200	571,400	46,400	**4,167,300**
Mar	2,116,700	100,200	248,900	6,500	**2,472,300**	3,650,900	671,000	715,700	54,200	**5,091,800**
Apr	2,067,300	98,700	253,700	6,400	**2,426,100**	3,565,700	660,800	729,600	53,100	**5,009,200**
May	2,245,300	114,000	287,600	7,700	**2,654,600**	3,872,700	763,300	827,200	64,500	**5,527,700**
Jun	2,153,700	109,700	284,900	7,200	**2,555,500**	3,714,600	735,100	819,200	59,800	**5,328,700**
Total	**24,513,100**	**1,213,500**	**3,069,400**	**78,900**	**28,874,900**	**$ 42,279,800**	**$ 8,127,700**	**$ 8,827,300**	**$ 658,300**	**$ 59,893,100**

[1] Includes revenue impacts due to leakage, including unpaid transactions.

6.6 Disclaimer

CDM Smith used currently-accepted professional practices and procedures in the development of the traffic and revenue estimates in this report. However, as with any forecast, it should be understood that differences between forecasted and actual results may occur, as caused by events and circumstances beyond the control of the forecasters. In formulating the estimates, CDM Smith reasonably relied upon the accuracy and completeness of information provided (both written and oral) by MDTA. CDM Smith also relied upon the reasonable assurances of independent parties and is not aware of any material facts that would make such information misleading.

CDM Smith made qualitative judgments related to several key variables in the development and analysis of the traffic and revenue estimates that must be considered as a whole; therefore, selecting portions of any individual result without consideration of the intent of the whole may create a misleading or incomplete view of the results and the underlying methodologies used to obtain the results. CDM Smith gives no opinion as to the value or merit of partial information extracted from this report.

All estimates and projections reported herein are based on CDM Smith's experience and judgment and on a review of information obtained from multiple agencies, including MDTA. These estimates and projections may not be indicative of actual or future values, and are therefore subject to substantial uncertainty. Future developments, economic conditions cannot be predicted with certainty, and may affect the estimates or projections expressed in this report, such that CDM Smith does not specifically guarantee or warrant any estimate or projection contained within this report.

While CDM Smith believes that the projections and other forward-looking statements contained within the report are based on reasonable assumptions as of the date of the report, such forward-looking statements involve risks and uncertainties that may cause actual results to differ materially from the results predicted. Therefore, following the date of this report, CDM Smith will take no responsibility or assume any obligation to advise of changes that may affect its assumptions contained within the report, as they pertain to socioeconomic and demographic forecasts, proposed residential or commercial land use development projects and/or potential improvements to the regional transportation network.

The report and its contents are intended solely for use by MDTA and designated parties approved by MDTA and CDM Smith. Any use by third-parties, other than as noted above, is expressly prohibited. In addition, any publication of the report without the express written consent of CDM Smith is prohibited.

CDM Smith is not, and has not been, a municipal advisor as defined in Federal law (the Dodd Frank Bill) to MDTA and does not owe a fiduciary duty pursuant to Section 15B of the Exchange Act to MDTA with respect to the information and material contained in this report. CDM Smith is not recommending and has not recommended any action to MDTA. MDTA should discuss the information and material contained in this report with any and all internal and external advisors that it deems appropriate before acting on this information.